

# INSECTS OF HAWAII

*A Manual of the Insects of the Hawaiian Islands, including an Enumeration of the Species and Notes on their Origin, Distribution, Hosts, Parasites, etc.*

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VOLUME 6

EPHEMEROPTERA-NEUROPTERA-TRICHOPTERA  
AND SUPPLEMENT TO VOLUMES 1 TO 5

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## PREFACE TO VOLUME 6

This sixth volume of *Insects of Hawaii* includes information concerning 58 species and subspecies in 12 genera, as follows: 1 immigrant mayfly (Ephemeroptera), 1 immigrant caddisfly (Trichoptera), and 7 immigrant and 49 endemic Neuroptera, including 27 brown lacewings, 24 green lacewings, 2 coniopterygids, and 3 antlions. Also included is a summary of the nomenclatorial changes made in this volume and a supplement in which are listed corrections and additions to the first five volumes of this series.

Until the autumn of 1955, when this manuscript was completed, about 38 additional species in the orders covered by the first five volumes—Apterygota through the Homoptera—had come to my attention. Since then, additional species have been recorded in Hawaii, and I hope to include records of them in the forthcoming seventh volume. About 1,200 species have now been listed in these texts.

The volumes of this series have been written to be used in conjunction with *Fauna Hawaiiensis* and the *Proceedings of the Hawaiian Entomological Society*, and it is assumed that those works will be available to the users of this book.

Reference should be made to the "Preface to the First Five Volumes," in Volume 1 of this series, for a detailed outline of the plan and scope of the volumes, general acknowledgments, and comment. The other volumes of this series are: I—Introduction; II—Apterygota to Thysanoptera; III—Heteroptera; IV—Homoptera: Auchenorrhyncha; and V—Homoptera: Sternorrhyncha. There now remain the Lepidoptera, Coleoptera, Strepsiptera, Hymenoptera, Diptera and Siphonaptera to be reported. At the time of the writing of this Preface, I have nearly completed Volumes 7 and 8 on the Macrolepidoptera and Pyrales, and much work on the volumes on the tortricid moths and two volumes on the Microlepidoptera has been done. Extensive manuscripts have been prepared for the several volumes treating the Coleoptera and Hymenoptera. Several years ago, I transferred to D. Elmo Hardy, University of Hawaii, the task of preparing the volumes on the Diptera, and we hope that the first volume on the Diptera will soon be ready and that the remaining Diptera volumes will appear without undue delay.

It is now my pleasure to thank most sincerely all those whose assistance and support have made the completion of this book possible.

I am most deeply indebted to the National Science Foundation, Washington, for their generous support and for their broad understanding of the problems involved in the project. The Foundation's aid rescued not only the manuscript for this book from loss, but the manuscripts for Volumes 7 and 8, which now await publication, have also been saved and completed at the British Museum (Natural History).

Work was begun on the text long ago during my early years at Bishop Museum, and it was continued after I joined the Experiment Station, Hawaiian Sugar

Planters' Association when C. E. Pemberton was my superior officer and Harold Lyon was Director of the Station. Both of these men gave full support to the project. Later, with the aid of the Trustees of the Sugar Planters' Association and a generous Fulbright grant, I was able to go to the British Museum in 1949; but only a small amount of preliminary work was done on part of this volume at that time.

My debt to the Trustees, the Director and the Staff of the British Museum (Natural History) is particularly great, because the preparation of this text absolutely could never have been accomplished without their cooperation. The collections and libraries at the British Museum in the fields of my research are by far the finest and best organized in the world.

I have been most fortunate in having Juliette Wentworth, who was chief editor of the first five volumes, edit this volume, although she has retired from the University of Hawaii Press and now lives with her geologist husband on the rim of Kilauea volcano. I also wish to thank Thomas Nickerson, who is in charge of the Press, and his staff, led by Aldyth V. Morris, for their assistance in carrying the volume through the processes of publication.

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The photographs were nearly all made at the British Museum (Natural History) by M. G. Sawyers and C. A. Horton, mostly by Mr. Horton; a few were made by J. T. Yamamoto, Experiment Station, Hawaiian Sugar Planters' Association, and Wallace Heaton, Ltd., London.

The detailed drawings are the work of Arthur Smith, British Museum (Natural History); the simple sketches are by me.

E.C.Z.

*British Museum (Natural History)*

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**INSECTS OF HAWAII**

## CHECKLIST OF THE INSECTS IN THIS VOLUME

### Order **EPHEMEROPTERA**

#### Superfamily CAENOIDEA

#### Family CAENIDAE

Genus **CAENIS** Stephens

**nigropunctata** Klapálek

### Order **NEUROPTERA**

#### Superfamily HEMEROBIOIDEA

#### Family HEMEROBIIDAE

Genus **SYMPHEROBIUS** Banks

**barberi** (Banks)

Genus **NESOBIELLA** Kimmins

**hospes** (Perkins)

Genus **NESOMICROMUS** Perkins

**angularis** Perkins

**angustipennis** Perkins

**bellulus bellulus** Perkins

**bellulus infumatus** (Perkins)

**brunnescens** Perkins

**distinctus** Perkins

**drepanoides** Perkins

**falcatus** Zimmerman

**forcipatus** Perkins

**fulvescens** Perkins

**haleakalae** Perkins

**latipennis** Perkins

**longispinosus** Perkins

**minimus** Perkins

**navigatorum** (Brauer)

**ombrias** Perkins

**paradoxus** Perkins

**rubrinervis** Perkins

**subochraceus** Perkins

**vagus** Perkins

Genus **PSEUDOPSECTRA** Perkins**cookeorum** Zimmerman**lobipennis** Perkins**swezeyi** Zimmerman**usingeri** ZimmermanGenus **NESOTHAUMA** Perkins**haleakalae** Perkins

## Family CHRYSOPIDAE

Genus **CHRYSOPA** Leach**lanata** Banks**microphya** McLachlanGenus **ANOMALOCHRYSA** McLachlan**angulicosta** Perkins**cognata** Perkins**debilis** Perkins**frater** Perkins**fulvescens fulvescens** Perkins**fulvescens rhododora** (Perkins)**haematura** Perkins**hepatica** McLachlan**longipennis** Perkins**maclachlani maclachlani** Blackburn**maclachlani simillima** (Perkins)**molokaiensis** Perkins**montana** Blackburn**ornatipennis** Blackburn**peles** Perkins**princeps** Perkins**raphidioides raphidioides** Perkins**raphidioides reticulata** (Perkins)**rufescens** McLachlan**soror** Perkins**sylvicola** Perkins**viridis** Perkins

Superfamily MYRMELEONTOIDEA

Family MYRMELEONTIDAE

Subfamily DENDROLEONTINAE

Tribe FORMICALEONTINI

Genus **EIDOLEON** Esben-Petersen  
**perjurus perjurus** (Walker)  
**perjurus violentus** (Walker)  
**wilsoni** (McLachlan)

Superfamily CONIOPTERYGOIDEA

Family CONIOPTERYGIDAE

Subfamily ALEUROPTERYGINAE

Genus **CONIOCOMPSA** Enderlein  
**zimmermani** Kimmins

Subfamily CONIOPTERYGINAE

Genus **CONIOPTERYX** Curtis  
**pembertoni** Kimmins

Order **TRICHOPTERA**

Family HYDROPTILIDAE

Genus **OXYETHIRA** Eaton  
**maya** Denning

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In the supplement to the first five volumes appended to the end of this volume, the following species, new to the Hawaiian list since the first five volumes were published, are included:

#### **ORTHOPTERA**

**Tenodera australasiae** (Leach)

#### **EMBIOPTERA**

**Oligotoma (Aposthonia) oceania** Ross

#### **THYSANOPTERA**

**Chirothrips patruelis** Hood

**Dichromothrips corbetti** (Priesner)

**Dichromothrips dendrobii** Sakimura

**Frankliniella minuta** (Moulton)

**Haplothrips (Haplothrips) fissus** Bianchi

**Haplothrips (Haplothrips) sesuvii** Priesner

**Liothrips urichi** Karny

**Parthenothrips dracaenae** (Heeger)

**Pseudocryptothrips remotus** Bianchi

**Scolothrips pallidus** (Beach)

**Scolothrips priesneri** Sakimura

**Taeniothrips vitticornis** (Karny)

#### **HEMIPTERA-HETEROPTERA**

**Corythucha morrilli** Osborn and Drake

**Cyrtorhinus lividipennis** Reuter

**Emesopsis nubilis** Uhler

**Fulvius brevicornis** Reuter

**Melanolestes picipes abdominalis** (Herrick-Schaeffer)

**Peregrinator biannulipes** (Montrouzier and Signoret)

**Polididus armatissimus** Stål

**Trigonotylus usingeri** Carvalho

#### **HEMIPTERA-HOMOPTERA**

##### **AUCHENORHYNCHA**

**Deltocephalus sonorus** Ball

**Exitianus exitiosus** (Uhler)

**Kunzeana kunzei** (Gillette)

**Nesosydne chenopodii** Zimmerman

**Scaphytopius (Convelinus) loricatus** (Van Duzee)

**Vanduzea segmentata** (Fowler)

**STERNORHYNCHA**

**Aphalara rumicis** (Mally)  
**Ceroplastes cistudiformis** Townsend and Cockerell  
**Dactylopius tomentosus** (Lamarck)  
**Macrosiphum luteum** (Buckton)  
**Octaspidiotus araucariae** Adachi and Fullaway  
**Odonaspis penicillata** Green  
**Pseudoparlatoria giffardi** Adachi and Fullaway  
**Pseudoparlatoria parlatoroides** (Comstock)  
**Radionaspis indica** (Marlatt)  
**Rhopalosiphum latysiphon** (Davidson)  
**Trionymus rostellum** Lobdell

**SUMMARY OF THE NEW NOMENCLATORIAL CHANGES  
 MADE IN THIS VOLUME**

**HEMIPTERA-HETEROPTERA****Miridae**

*Orthotylus kassandra* Kirkaldy is a new synonym of *Orthotylus daphne* Kirkaldy.

**NEUROPTERA****Hemerobiidae**

*Eumicromus* Nakahara is a new synonym of *Nesomicromus*.

*Eumicromus navigatorum* (Brauer) is transferred to *Nesomicromus*.

*Nesomicromus infumatus* Perkins is reduced to a subspecies of *Nesomicromus bellulus* Perkins.

*Nesomicromus minor* Perkins is a new synonym of *Nesomicromus bellulus* Perkins.

*Nesomicromus molokaiensis* Perkins is a new synonym of *Nesomicromus bellulus* Perkins.

*Nesomicromus stenopteryx* Perkins is a new synonym of *Nesomicromus haleakalae* Perkins.

**Chrysopidae**

*Anomalochrysa gayi* Perkins is a new synonym of *Anomalochrysa maclachlani* Blackburn.

*Anomalochrysa nana* Perkins is a new synonym of *Anomalochrysa debilis* Perkins.

*Anomalochrysa paurosticta* Perkins is a new synonym of *Anomalochrysa maclachlani* Blackburn.

*Anomalochrysa reticulata* Perkins is reduced to a subspecies of *Anomalochrysa raphidioides* Perkins.

*Anomalochrysa rhododora* Perkins is reduced to a subspecies of *Anomalochrysa fulvescens* Perkins.

*Anomalochrysa simillima* Perkins is reduced to a subspecies of *Anomalochrysa maclachlani* Blackburn.

*Anomalochrysa zoe* Perkins is a new synonym of *Anomalochrysa maclachlani* Blackburn.

#### **Myrmeleontidae**

*Formicaleo perjurus* (Walker) McLachlan is transferred to *Eidoleon*.

*Formicaleo perjurus violentus* (Walker) McLachlan is transferred to *Eidoleon*.

## Division **EXOPTERYGOTA** Sharp, 1898, continued from Volume 5

Since Volume 2 of this series was published, the identity of a newly established immigrant species of Ephemeroptera has been recorded. The order was not previously known in Hawaii. Its proper place in *Insects of Hawaii* is just before the Odonata in Volume 2.

### Order **EPHEMEROPTERA** (Leach) Haeckel, 1896

(*ephemeron*, a mayfly, living but a day; *ptera*, wings)

*Odontota* Latreille, 1806.

*Ephemerida* Leach, 1817.

*Ephemerina* Burmeister, 1829.

*Anisoptera* Leach, 1835.

*Agnatha* Meinert, 1883.

*Plectoptera* Packard, 1886.

*Archipterygota* Börner, 1909.

#### The Mayflies

The early name *Odontota* is undesirable for use for this order because of the chance of confusion with Odonata. Comstock followed Leach in the use of *Ephemerida*, as did Essig in 1942. Tillyard followed Packard's use of *Plectoptera*, but this is undesirable for reasons in addition to the resemblance to *Plecoptera*. Imms followed Haeckel and used *Ephemeroptera*, and I believe that this form of the old Leach name is desirable because it conforms with most of the other ordinal names which end in *ptera*. It would be better if all ordinal names had the same suffix.

Head hypognathous, moderate in size, short, transverse, free. Mouthparts vestigial or aborted in adult; mandibles rudimentary or absent; maxillae vestigial, but small, palpi usually present; labium reduced, with vestigial palpi in some forms. Eyes large, larger in males than females; in some forms the eyes of the males are divided; three ocelli present. Antennae short, setiform, with two basal segments and a terminal, indistinctly multi-segmented filament. Thorax generalized, mesothorax always larger than pro- or metathorax, extraordinarily large in

some forms. Legs variable, usually weak except for the fore pair, which are elongated in males of some species; not adapted for active walking; tarsi one- to five-segmented; claws simple or modified. Wings held vertically above body when at rest, triangular, hind wings reduced or absent; venation primitive, many species with numerous intercalary or accessory veins and cross-veins giving a characteristic net-like effect, the intercalary veins often with their origins detached from the normal positions of forking, the veins following a convex and concave alternating pattern, thus giving the fore wings a corrugated or pleated appearance (see Tillyard, 1926, for a detailed discussion of venation). Abdomen slender, 10-segmented; cerci strongly developed as a pair of very long, multi-segmented, thread-like, terminal filaments, and usually with a third similar, median, caudal filament; spiracles on segments one to eight. Terminalia: in male with segmented "claspers" and double aedeagus; no ovipositor in female, oviducts opening separately into vulva between ventrites seven and eight.

Metamorphosis incomplete. Eggs of many types, many remarkable in form; deposited in water. Some forms discharge their eggs in two masses, some wash them off the abdomen and into the water in small clusters, and others descend under water to deposit eggs in batches under stones, etc. Some species are known to lay several thousand eggs per female. The first stage naiads have no gills, but a pair of gills arises at the first molt, and a pair or two of additional gills may develop at each successive molt until most species have seven pairs. The number of molts may be great. The naiads are multiform and have varied habits; their compound eyes and ocelli are both developed and the caudal appendages are long and conspicuous. Most species are herbivorous, but some few are carnivorous. Some naiads lead a free, exposed, roaming life; others spend most of their time concealed beneath stones and other objects, some live in masses of debris or in sand or mud, and others dig burrows. When the naiad reaches maturity it rises to the surface of the water where, usually in a matter of a few moments, a winged sub-imago bursts from the nymphal shell and flies away. This sub-imago is enclosed in a delicate pellicle and has milky-colored wings. It flies to an object where it can rest, and there, after only a few minutes or several hours, it sheds the pellicle and emerges as a fully formed adult, usually with hyaline wings and sexually functional. This spectacular feature is unique among insects. The adult may then live for only a few hours to a few days. Some species emerge at dusk, shed their pellicles, mate, deposit their eggs, and die before the next day dawns. This is why the mayflies are called ephemerids. Many species develop in enormous numbers, and countless millions may arise from the surface of a small lake. Mating takes place in the air, and their "mating dance" flights are a characteristic feature of their life histories. Oviposition proceeds immediately following fertilization.

Mayflies form one of the most important foods of fresh-water fish. Many artificial flies used by trout fishermen have mayflies as models. In England, a land of keen fishermen, the relationship between mayfly and trout is a subject of intensive study and books have been written on the subject. In New Zealand, where there are numerous, fine species of mayflies, the introduction of trout has brought some ephemerids close to extinction.

Some species create a nuisance by swarming to lights in overwhelming numbers, and the naiads of one species have been reported damaging submerged wooden structures in Siam by burrowing into hard wood, somewhat in the manner of teredos (see Vejabhongse, 1937:53).

Ephemeroptera are widespread over the continents, and the number of known species approximates 1,500. Tillyard (1926) recorded 20 known species in Australia and the same number in New Zealand. One apparently endemic species occurs in Samoa, and from Fiji westward the numbers of species increase rapidly until the well-developed faunas of Indonesia are reached. There are no native mayflies east of Samoa in Polynesia; a single, immigrant species represents the order in Hawaii. Mayflies go far back in the fossil record to the Lower Permian.

Edmunds and Traver, in their new suprageneric classification (1954:236), divide



Figure 1—*Caenis nigropunctata* Klapálek, female. Honolulu; expanse, 9 mm. Note the eggs adhering to right side of abdomen. The anal filaments of the male are much longer than those of the female and are about three times as long as the length of a wing.

the order into five superfamilies: Heptagenioidea (=Siphonuroidea, Baetoidea), Leptophlebioidea, Caenoidea, Ephemeroidea and Prosopistomatoidea. Only the Caenoidea is represented in Hawaii.

### Superfamily CAENOIDEA

This superfamily contains two families, one of which is now represented in Hawaii.

#### Family CAENIDAE Klapálek, 1909

This family contains small species whose fore wings are milky and have few cross-veins, the subcosta is free and separated from the radius, the anterior median (MA, sometimes called  $R_{4+5}$  or M) is forked, and the hind wings are absent. Each sex has three caudal filaments. The naiads are unusual because the first pair of gills are each greatly enlarged to form specialized operculum-like structures which conceal the following five gills. This forms a protective device to guard the functional respiratory gills and is correlated with the muddy environment frequented by the naiads.

#### Genus CAENIS Stephens, 1833

This genus has representatives in many regions.

**Caenis nigropunctata** Klapálek (fig. 1).

*Caenis nigropunctata* Klapálek, 1904:104.

Oahu.

Immigrant. Originally described from Java and known also from Sumatra, Bali and the Philippines. The first specimens of this species found in Hawaii were obtained by C. E. Pemberton on July 29, 1944, from an assortment of insects collected in an east-bound airplane at Honolulu, and it is presumed that the specimens entered the aircraft at Honolulu. On August 9, 1944, W. M. Herms and T. C. Russell collected a series of the species at a light trap at Pearl City, near Honolulu. In January, 1945, it had spread to the University of Hawaii, where it was found by D. D. Jensen, and in June, 1948, F. A. Bianchi found it abundant at lights at Kailua, Oahu, on the opposite side of the island.

The naiads have not been found in Hawaii, but they must be abundant. I regret that I cannot illustrate the naiad here.

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Division II. **ENDOPTERYGOTA** Sharp, 1898  
(*endo*-, inside; *pterygotos*, winged)

*Holometabola.*

This subdivision of the subclass Pterygota contains those insects which pass through a complex metamorphosis in which the wings develop internally during larval life and in which there is always a pupal instar. The young animals are specialized larvae instead of generalized nymphs and, as a rule, bear little resemblance to their adult stages.

Division I, the Exopterygota—which contains the orders Orthoptera, Isoptera, Embioptera, Dermaptera, Zoraptera, Corrodentia, Mallophaga, Anoplura, Ephemeroptera, Odonata, Thysanoptera and Hemiptera—is discussed on page 73 of Volume 2 of this series. In the Exopterygota no true pupa is formed, and, as a general rule, the wings develop externally upon the young, which are generalized nymphs, most of which, more or less, resemble the adult insects except for the development of wings and genitalia. A transition between the two groups is indicated in the Thysanoptera and certain of the sternorhynchous Homoptera where resting stages indicative of pupae or incipient pupae are developed.

The Endopterygota contains many times the number of species included in the lower groups. It includes the following orders: Megaloptera, Raphidiodea, Neuroptera, Mecoptera, Trichoptera, Lepidoptera, Coleoptera, Strepsiptera, Hymenoptera, Diptera and Siphonaptera. The only orders of this list represented by endemic insects in Hawaii are the Neuroptera, Lepidoptera, Coleoptera, Hymenoptera and Diptera. Species of Trichoptera, Strepsiptera and Siphonaptera have been accidentally introduced, however. The predaceous orders Megaloptera (larvae aquatic), Raphidiodea (larvae terrestrial) and Mecoptera (larvae terrestrial) remain unrepresented in Hawaii.

A key to the orders of insects found in Hawaii is given in Volume 2 (pp. 25–28) of *Insects of Hawaii*. The orders of Endopterygota now established in the Hawaiian fauna may be distinguished as follows:

KEY TO THE ADULTS OF THE ORDERS OF ENDOPTERYGOTA FOUND IN HAWAII

1.   Wings absent.....2  
      Wings present.....6
- 2(1). Body greatly and conspicuously compressed laterally,  
       much higher than broad, with numerous, posteriorly-directed, stout spines; small, active, jumping ectoparasites living on birds or mammals. **Siphonaptera.**  
      Body not laterally compressed.....3

- 3(2). Body larvaeform, sac-like, legless, head and thorax fused, antennae and eyes absent; parasites of Hymenoptera and leafhoppers. . . . . female **Strepsiptera**.  
Not such degenerate organisms, although some may be larvaeform; legs and eyes present. . . . . 4
- 4(3). Mouth non-functional, well-developed mandibles or a beak not developed; larvaeform females only (Rhipiphoridae). . . . . part of **Coleoptera**.  
Mouth parts fitted with strong mandibles or with a beak and/or fitted for lapping and sucking or piercing. . . . . 5
- 5(4). Mouth parts fitted with biting and chewing mandibles; abdomen greatly constricted at base and joined to thorax by a slender petiole. . . . . wingless **Hymenoptera**.  
Mouth parts fitted for lapping or sucking or piercing and sucking and without biting mandibles; abdomen appearing rather broadly joined to thorax. . . . .  
. . . . . wingless **Diptera**.
- 6(1). With only two well-developed wings. . . . . 7  
With four wings. . . . . 9
- 7(6). Fore wings represented by a pair of clavate processes, hind wings well-developed. . . . . male **Strepsiptera**.  
Fore wings well-developed, hind wings represented by a pair of halteres, greatly reduced or absent. . . . . 8
- 8(7). Mouth parts fitted with well-developed mandibles for biting and chewing; palpi long and conspicuous, maxillary palpi five-segmented, labial palpi three-segmented. . . . . part of **Neuroptera**.  
Mouth parts fitted for lapping, sucking or piercing; mandibles, if present, incorporated with proboscis and not obvious as mandibles; maxillary palpi, if distinguishable, not more than four-segmented, labial palpi absent. . . . . **Diptera**.
- 9(6). Mouth parts fitted for sucking, siphon-like or vestigial, but not mandibulate. . . . . 10  
Mouth parts fitted with mandibles. . . . . 11
- 10(9). Wings roughly hairy; mouth parts, except palpi, vestigial; larvae aquatic, case-makers. . . . . **Trichoptera**.  
Wings covered with scales; mouth parts usually developed into a coiled proboscis. . . . . **Lepidoptera**.
- 11(9). Fore wings leathery or corneous, not membranous, obviously of a denser texture than membranous hind wings, which are usually concealed by fore wings. . . . . **Coleoptera**.  
Fore and hind wings membranous and of similar texture. 12

- 12(11). Abdomen broadly joined to thorax and without a distinct basal petiole; wings held roof-like over body when at rest; hind wings not capable of being hooked to fore wings as in Hymenoptera . . . . . **Neuroptera.**

Abdomen with a conspicuous basal constriction and joined to the compound "thorax" by a narrow petiole; hind wings with a row of sclerotized hooks along costal margin by which they are able to be hooked to the fore wings; wings not held roof-like over body when at rest . . . . . **Hymenoptera.**

My good friend Dr. Fritz van Emden of the Commonwealth Institute of Entomology, has kindly prepared an abstract of one of his manuscripts on insect larvae and adapted a key to the larvae of the Hawaiian Endopterygota for this volume. I have recast his notes to fit the style of my book, but the following material on the larvae is basically van Emden's.

It has been found that the larvae can be defined about as clearly as the adults. The larvae of the higher insects, or Endopterygota, may be characterized as tracheate Arthropoda with or without thoracic legs. The legs consist of not more than five main divisions: coxa, trochanter, femur, tibia and tarsus, and they are attached to the first three segments immediately behind the head. Compound eyes are absent in all except for a few in which segmented legs are absent; lateral ocelli (up to six on each side, except in certain Neuroptera which have seven) may or may not be present. The labium is never incorporated in the formation of a suctorial organ (but the mandibles or the maxillae, or the mandibles and the maxillae may together form a suctorial organ). External traces of wings (except in teratological "prothetelic" specimens) are absent. The abdomen has more than four segments, some of which may bear prolegs or gills, but none bears any vestigial true legs (no styli, etc.). External genitalia are absent.

#### KEY TO THE LARVAE OF THE ORDERS OF HAWAIIAN ENDOPTERYGOTA

1. Thorax with at least two or three pairs of distinct legs which are at least conical or truncate cylindrical processes; anus open and functional; labium with at least vestigial palpi (except in many Bruchidae); mandibles move in a horizontal plane; (endoparasites in insects or other animals will be more easily identified if placed in the next section even if they appear by their thoracic legs to belong to this section) . . . . . 2

Thorax without distinct legs, or only with a single or paired truncate process on prothorax, sometimes with slight, convex, cushion-like prominences or three pairs of long setae, but never with paired stumps on meso- or metathorax, and never with jointed legs . . . 5

- 2(1). Maxilla fitted into a groove on ventral surface of mandible so that a suctorial organ is formed by each pair of organs; mouth closed; apex of abdomen without cerci or other external appendages; abdomen without spurious legs; thoracic legs with two claws; six or seven ocelli on each side of head. . . . . **Neuroptera.**

Maxilla and mandibles never together forming suctorial organs, although either the mandible or the maxilla may be a separate suctorial organ. . . . . 3

- 3(2). Abdomen with a pair of claw-like, terminal, ventro-lateral appendages which usually are placed on distinct spurious legs; dorso-lateral terminal appendages absent; thoracic legs with a separate tarsal segment and a single claw (that is, with three sections—tibia, tarsal segment and claw—beyond the “knee”); antennae one-segmented; labial palpi two-segmented; one ocellus on each side of head. . . . . **Trichoptera.**

Apex of abdomen either without claw-like ventro-lateral, terminal appendages, or with more than one claw-like appendage on each side. . . . . 4

- 4(3). Labium with a glandular orifice at tip of ligula, the duct of the silk gland extending through the labium; ninth and one or more of the third to sixth abdominal segments usually with prolegs which bear regularly arranged crotchets, rarely are both prolegs and crotchets absent; thoracic legs with three segments (tibia, tarsus and one claw) beyond the “knee,” unless the legs are reduced; labrum not fused; six ocelli on each side of head; maxillary lobe with two two-segmented styli; frontale (frontal sclerite) with a triangular system of ventral, dark, endoskeletal keels. . . . . **Lepidoptera.**

Labium with or without a ligula, but its tip always without a glandular orifice; if the ninth (or tenth) abdominal segment is provided with proleg-like structures, then the other abdominal segments do not have such organs; if the thoracic legs have a separate tarsus, the tarsus has two claws instead of only one, or the labrum is fused with clypeus and frontale; none to six ocelli on each side of head; frontale with or without dark endoskeletal keels, but never with an anterior transverse keel completing a triangle. . . . . **Coleoptera.**

- 5(1). Not endoparasitic in insects or other animals. . . . . 6

- Endoparasitic in insects or other animals; mouth parts and antennae strongly reduced; ocelli absent. . . . . 11
- 6(5). Labium with the orifice of a spinning gland in place of or at the tip of the ligula, this is seldom shifted to the disc of the dorsal surface (hypopharynx), but in such cases the anus is closed and non-functional during larval life. . . . . 7
- Labium without a spinning gland and without a glandular orifice on the ligula, but sometimes with a glandular orifice on the hypopharynx; anus open and functional (except in certain resting stages). . . . . 8
- 7(6). Anus closed, non-functional until just before pupation; venter without groups of crotchets; ligula indistinct; with at most one ocellus on each side of head; antennae more or less broadly separated from mouth-frame, vestigial or at most one-segmented; maxillary and labial palpi absent, vestigial or at most distinctly one-segmented. . . . . **Hymenoptera (Apocrita).**
- Anus open and functional; ventral surface of the last and third to sixth abdominal segments or of some of them almost always with a pair of groups of regularly arranged crotchets; ligula well-developed, orifice of spinning gland situated at its tip; normally with six ocelli on each side of head; frontale with a complete triangle of endoskeletal keels. . . **Lepidoptera.**
- 8(6). Mandibles movable in a vertical plane and parallel to each other; head capsule more or less reduced, if distinct, it projects into thorax in a pair of "metacephalic rods" or in an unpaired "cephalic plate"; spiracles of first to seventh abdominal segments usually absent, seldom small and non-functional, very rarely well-developed and functional. . . . .
- . . . . . **Diptera (Brachycera and Cyclorhapha).**
- Mandibles opposed and moving in a horizontal plane toward each other; head capsule well-developed (except in Cecidomyiidae). . . . . 9
- 9(8). Spiracles of abdominal segments one to seven usually absent, seldom well-developed but then the spiracles of the eighth abdominal segment are on a pair of elongate, sclerotized tubes (Scotopsidae), or the head capsule is strongly reduced (Cecidomyiidae, in which the prosternum frequently has an elongate, median sclerite, the "spatula sternalis"), or mandibles lamelliform and reminiscent of a sector of a cog wheel (Mycetophilidae); labial palpi vestigial or absent,

- never more than one-segmented . . . . .
- . . . . . **Diptera (Nematocera).**
- Spiracles of abdominal segments one to seven well-developed, similar to those on the eighth, or, in *Cercyon*, with labial palpi plainly two-segmented; thorax with only one pair of spiracles (in meso- or prothorax); spiracles of eighth abdominal segment not on elongate paired tubular processes; head capsule well-developed, mandibles not lamelliform. . . . . 10
- 10(9). Tenth abdominal segment well-developed, segment-like, only moderately smaller than the ninth and of similar build, with a pair of conical appendages (cerci); spiracles smaller than the sockets of the heavier setae; maxillary palpi two-segmented; labial palpi one-segmented, with a pair of moderately long, rod-like setae at tip and between these setae a pair of long setae; antenna one-segmented, but sometimes appearing two-segmented; a glandular duct present with an orifice on the hypopharynx (called a salivary duct, but probably a spinning gland) . . . **Siphonaptera.**
- Tenth abdominal segment absent or small, wart-shaped, forming not much more than an anal papilla, and without appendages (other than protrusible ones); spiracles larger than the setal sockets. . . . .
- . . . . . part of the **Coleoptera.**
- 11(5). Mandibles movable in a vertical plane and parallel to one another; only the spiracles of the mesothorax and eighth abdominal segment functional and distinct; labium without palpi and without a spinning gland. . . . . **Diptera (Brachycera and Cyclorhapha).**
- Mandibles often vestigial, but movable, or at least directed toward each other in a horizontal plane; spiracles non-functional or functional, but if functional reduction of the spiracles proceeds from the caudal end cephalad, or the last abdominal pair alone is functional. . . . . 12
- 12(11). Labium without the orifice of a spinning gland; antennae close to margin of mouth, or thoracic legs distinct. . . . . **Coleoptera (including Strepsiptera).**
- Labium with the orifice of a spinning gland in place of the ligula; antennae broadly separated from the margin of the mouth, sometimes not traceable; thoracic legs never present; maxillary and labial palpi never more than one-segmented, often vestigial or absent. . . . . **Hymenoptera (Apocrita).**

Order **NEUROPTERA** Linnaeus, 1758  
(*neuron*, nerve; *ptera*, wings)

Lacewings, Antlions, Mealywings, etc.

This is the only order of the neuropteroid complex which is represented in our endemic fauna. The unrepresented orders are the Megaloptera (sialids, dobsonflies), Raphidiodea (snakeflies) and Mecoptera (scorpionflies). The Megaloptera and Raphidiodea are predaceous in the larval and adult stages, and, although most of the Mecoptera are predaceous, some are phytophagous. Some authors treat the Megaloptera as a suborder of Neuroptera and include the Raphidiodea as a superfamily of the Megaloptera, and the other families are included in the suborder Planipennia (see Tillyard, 1926:313). I have not followed this treatment. The Megaloptera and Mecoptera are found on all the continents; the Raphidiodea, although widespread in the Holarctic, are not represented in Australia or in Africa south of the Sahara, and only one species has been reported from South America.

Head hypognathous, moderate in size, usually broader than long, fully exposed, free. Mouth parts complete, of the biting and chewing type; labrum broad; mandibles well-developed, toothed; maxillae with lacinia and galea, palpi five-segmented; labium with three-segmented palpi, mentum well-developed, ligula absent or not well-developed; hypopharynx developed, often trilobed. Eyes large, widely separated; ocelli present or absent, three in number when present. Antennae variable, short to very long, moniliform or filiform, setiform to clavate or capitate, multisegmented. Thorax generalized; prothorax variable, small to large, short to elongate; mesothorax strongly developed, with scutum tripartite and with a moderate scutellum, pleura well-developed, sternum small; metathorax as mesothorax, but smaller; two pairs of thoracic spiracles present. Legs simple, cursorial, tarsi five-segmented. Wings always present, usually four, but some aberrant forms with fore wings only, held roof-like over the body when at rest; some forms have a primitive wing-coupling mechanism, but most lack such apparatus; venation variable, but usually characterized by numerous accessory veins, cross-veins and terminal twigging, the media and cubital complex frequently assuming misleading arrangements which often can be interpreted only by careful study of the developing wings, the various branches of Rs, M and Cu frequently taking zigzag courses and fusing to form false M and false Cu; some of our aberrant Hemerobiidae with leathery, almost elytra-like fore wings with unusual, coarse, reticulate venation (see the illustrations of *Pseudopsectra* and *Nesothauma*). Excluding the divergent Coniopterygidae whose wing venation departs greatly from the usual form found in the order and which needs special explanation, the discussion of neuropterous venation by Tillyard (1926:309-310) is worth including here. The venation shows

all stages in the development of a complete pectinate radial sector, an abundant cross-venation and a complete marginal series of tiny twiggings of the veins, often separated by marginal dots which are the sockets of stiff hairs; main veins hairy, but cross-veins seldom so, and membrane never. *Sc* a long, straight vein, with numerous costal veinlets, ending at or within the pterostigma, which is sometimes formed only by numerous, closely parallel veinlets, sometimes more or less strongly thickened; costal veinlets sometimes branched or connected by cross-bars; the first of the series, or humeral veinlet (*hm*), sometimes a recurrent vein . . . with numerous branches, especially when costal space is enlarged. *R*<sub>1</sub> a strong, straight vein running close below *Sc* and often sending numerous veinlets apically into pterostigma. *Rs* arising near base and usually very highly developed as a pectinate vein with many obliquely descending branches, but often with *R*<sub>4+5</sub> keeping the more primitive, dichotomic form. *M* rarely with four branches, usually reduced to three or two only, and often nearly squeezed out of existence by the over-development of *Rs*. *Cu*<sub>1</sub> a strong vein, always branched, often with a pectinate series of descending branches; *Cu*<sub>2</sub> a weak concave vein, sometimes shortened or absent. Three anal veins are present, often branched. In many forms the consecutive branches of main veins are separated by definite furrows in the membrane; of these, one between *Rs* and *M* and one between *M* and *Cu*<sub>1</sub> are most clearly defined.

Abdomen 10-segmented, first segment reduced, spiracles on first eight segments, segment nine small and 10 much reduced; cerci absent; ovipositor present or absent; male genitalia symmetrical, not very complex in our forms.

Metamorphosis complete. Eggs smooth or sculptured, laid singly or in groups, attached to the ends of long stalks in some species, but without stalks in others, micropyle usually protuberant. Larvae active carnivores, mostly terrestrial or arboreal (all our species fall in these categories, but some extra-Hawaiian species are aquatic); legs well-developed, but with tibial and tarsal articulation not or only partially free; oral opening non-functional, mandibles unusual (developed for piercing and sucking the juices of their prey), usually slender and somewhat sickle-shaped, their long sides grooved and the long, slender maxilla fitting closely under this groove to form a closed tube, the combination of maxilla and mandible forming a highly developed sucking-jaw; silk glands opening from the anus, the silk formed by six specially developed Malpighian tubes of the eight present, the silk-producing material stored in the hind gut, which is specialized as a silk reservoir. The larva, feeding only on the juices of its prey, does not defecate during its life, and it stores up only a small amount of residue from its highly concentrated liquid food supply, and there is, therefore, no open passage between the mid and hind guts, and since the hind gut has been developed into a silk reservoir, the waste products are stored until the adult emerges from the cocoon and is expanding and drying, at which time the waste is passed out as a concentrated black mass of excreta; the silk-producing Malpighian tubes give off a viscous fluid during the first two larval instars, and this fluid, which is waste matter derived from midgut digestive products, can be exuded at will from the anal papillae and is used as an adhesive substance with which the larva can attach itself at periods of molt; the character of some of the cells of the tubes changes during the third instar when silk is being produced and stored; there are three larval instars. Pupa enclosed within a silken cocoon, free; equipped with strong mandibles with which it cuts its way out of the cocoon before the adult emerges, and the pupa may become quite active when it is ready to transform and may wander about before the imago emerges. The adults are usually rather soft, delicate insects.

The flight of most species is rather slow and may appear weak and of a fluttering type. Flight is most common in the evenings or after dark, and many species are



attracted to lights. The adults of many species feign death when disturbed, and they are mostly nocturnal in habit.

The order is of ancient lineage and has been traced back in the fossil record to the Lower Permian in Kansas and the Upper Permian in Australia and Russia. There are said to be about 4,000 described living species of Neuroptera. I share the opinion that the Neuroptera show relationships with the Coleoptera.

The Hawaiian fauna contains native representatives of only the Hemerobiidae, Chrysopidae and Myrmeleontidae. The Coniopterygidae are represented only by immigrant species. Hawaii lacks representatives of the following 14 families of Neuroptera.

Ithonidae (Australia, Himalayas, California; the larvae have been reported to prey upon scarabs and other soil-dwelling larvae, but some authors discredit the reports in spite of Tillyard's claim (1926:312) that they do prey heavily on scarab larvae).

Dilaridae (Eurasia, Africa, North and South America, but not Australasia; nothing seems to be known of their biology).

Psychopsidae (best developed in Australia, with other species in the Oriental and Ethiopian regions; the known larvae have been found under bark).

Berothidae (Africa, Asia, Australia, New Zealand and North America; little is known of the biology, but the larvae of some may feed upon certain lepidopterous caterpillars).

Sisyridae (a nearly world-wide family whose larvae are most unusual in being aquatic and feeding upon fresh-water sponges).

Mantispidae (nearly world wide; the known larvae are hypermetamorphic and feed on certain spider eggs and young and on certain wasp larvae; the peculiar adults have the thorax, head and fore legs developed in an extraordinarily similar form to those of the Mantidae, and this parallel evolution is one of the marvels of the insect world).

Polystoechetidae (North, Central and South America; biology not known).

Osmylidae (Ethiopian, Eurasian to Australia and New Zealand, South American, but not North America; the known larvae are aquatic or semi-aquatic, and some prey upon dipterous larvae).

Apochrysidae (Asiatic, Oriental to Australia and Papua; habits evidently similar to those of the Chrysopidae).

Nemopteridae (Ethiopian, Eurasia to Australia, South America; largely confined to arid regions; the larvae live in dust, dry debris, soil or sand and prey upon various insects).

Nymphidae (Australia, New Guinea, Norfolk Island; larvae terrestrial and predaceous).

Myiodactylidae (Australia, New Guinea, Lord Howe Island; larvae arboreal and predaceous).

Stilbopteridae (only a few Australian and South American species known; larvae terrestrial carnivores; the swift-flying adults resemble dragonflies).

Ascalaphidae (found on all the continents; larvae terrestrial and predaceous; the adults of some are sometimes confused with Odonata; they capture their prey while flying).

It is of interest that Australia has the richest of all neuropterous faunas; it lacks representatives of only the Dilaridae and Polystoechetidae. Many of the neuropterous families are of ancient lineage, and it is significant that the greatest contemporary development of the order is in old Australia. New Zealand, on the other hand, has only a few species representing the families Berothidae, Coniopterygidae, Hemerobiidae, Myrmeleontidae and Osmylidae, and it is the only temperate zone region which lacks Chrysopidae, according to Tillyard (1926:311). The islands of Polynesia have only meager neuropterous faunas, and in this region it is only in Hawaii that we know of any complexes of species such as those of our Hemerobiidae and Chrysopidae.

Many species of Neuroptera serve man well, because they are active predators upon such insects as aphids, psyllids, aleyrodids, thrips, young leafhoppers and other small insects; others prey on mites, and on the eggs of acarina and various insects. Some feed on caterpillars. Many species are voracious "aphis lions." The larvae and adults of all Hawaiian species are predators. The adults, however, are

also known to feed upon such sweet substances as honeydew. It appears, however, that eggs are rarely produced or cannot be produced by the adults of some species fed on sweets alone, and "blood" meals seem essential to egg production.

A number of species have been used in biological control programs, and here in Hawaii we have purposely introduced *Symphorobius barberi* Banks and *Nesomicromus navigatorum* (Brauer), which have become established and prey upon mealybugs and aphids. In addition to these two species, certain other species were introduced but, for unknown reasons, failed to become established. These include a "*Chrysopa*" introduced from Australia in 1904 to prey upon aphids, and an unidentified hemerobiid introduced from Mexico in 1922 as an enemy of *Pseudococcus*. This is an unfortunately small number of neuropterous insects to be used in biological control work here, and I feel that we should introduce a number of other species in an effort to bring our aphids and coccids under more efficient control.

The reader who wishes more detailed information on the anatomy, morphology and bionomics of the Neuroptera is referred especially to Killington's excellent work (1936, 1937) on the British fauna.

The Hawaiian Neuroptera constitute one of the most taxonomically difficult of all the groups of insects I have studied, and I am not very happy with the results of my tedious labor. Their variability is extraordinary, highly confusing and might even try the patience of a saint! An incautious person, inexperienced with conditions in Hawaii and working with a limited series of specimens, might

TABULAR ANALYSIS OF THE HAWAIIAN NEUROPTERA

FAMILY	GENERA	ENDEMIC GENERA	NON-ENDEMIC GENERA	SPECIES	ENDEMIC SPECIES	ADVENTIVE SPECIES
Hemerobiidae.....	5	2	3	27	24	3
Chrysopidae.....	2	1	1	24	22	2
Coniopterygidae.....	2	0	2	2	0	2
Myrmeleontidae.....	1	0	1	3	3	0
Totals.....	10	3	7	56	49	7

Percentage of endemism in native group: genera, 75 percent; species, 100 percent.

Percentage of present-day fauna native: 87 percent.

Percentage of present-day fauna adventive: 12 percent.

Average number of species per genus in native group: 9.5.

Average number of species per genus in adventive group: 1.1.

The figures in this and similar tables in this work may be explained as follows:

1. "Percentage of endemism in native group: genera" means the percentage obtained by dividing the number of endemic genera by the total number of genera containing native (endemic and indigenous) species.

2. "Percentage of endemism in native group: species" means the percentage obtained by dividing the number of endemic species by the total number of endemic plus indigenous species.

3. "Percentage of present-day fauna native" is obtained by dividing the total number of endemic plus indigenous species by the total number of species recorded from the islands (endemic + indigenous + adventive).

4. "Percentage of present-day fauna adventive" is, similarly, the total number of species divided into the total of adventive species.

5. The average number of species per genus is obtained simply by dividing the total number of species in the native or adventive group by the total number of genera containing those species.

For purposes of simplification, I have combined species and lesser categories and have given them all equivalent rank.

describe a large number of individual variants as "new species." Extreme caution is required before new species in this order are described from Hawaii. One can make keys to individuals, but to be sure he is making a key to species is quite another matter, and this applies especially to the most confusing Chrysopidae.

#### KEY TO THE SUPERFAMILIES OF ADULT NEUROPTERA FOUND IN HAWAII

1. Small insects (not over 5 mm. long in our fauna) covered with a white, powdery exudation; wings with few simple veins which lack terminal forkings, and only a few cross-veins present (as in figure 102).....**Coniopterygoidea.**

Mostly much larger insects, and not covered by such an exudation; wings with many branching veins and cross-veins..2

2. Antennae entirely moniliform or filiform and without a terminal club.....**Hemerobioidea.**

Antennae enlarged distally to form a distinct club.....**Myrmeleontoidea.**

#### KEY TO THE LARVAE OF THE FAMILIES OF NEUROPTERA FOUND IN HAWAII

1. Very stout, somewhat rotund species living concealed at the bottom of cone-shaped pits in dry sand or earth; mandibles very long, stout, curved, forceps-like, toothed along inner edges.....**Myrmeleontidae.**

Not such organisms; mandibles not toothed; living free on plants.....2

- 2(1). Tarsus with a conspicuous trumpet-shaped empodium.....**Chrysopidae.**

Empodium much reduced and pad-like (*except* in first stage larvae of Hemerobiidae where the empodium is trumpet-shaped and similar to that in the Chrysopidae, but such an empodium is absent from later stages).....3

- 3(2). Mandibles large, prominent, curved; labial palpi slender, setiform, less prominent than mandibles; antennae without long hairs.....**Hemerobiidae.**

Mandibles small, straight and needle-like; labial palpi very prominent, stout, claviform, much more prominent than mandibles; antennae with long hairs.....**Coniopterygidae.**

## Superfamily HEMEROBIOIDEA

This is the largest superfamily in the Neuroptera, but only the two following families have representatives in Hawaii:

## KEY TO THE FAMILIES OF HEMEROBIOIDEA FOUND IN HAWAII

1. Radius of fore wings with two or more sectors; usually with many branched cross-veins between costa and subcosta; wing margins, between apices of veins, with dot-like, setose, thickened areas (trichosors) (veins in some endemic forms highly modified, not or hardly distinguishable as normal veins, and resulting in the wings being coriaceous and areolated, and in such species the hind wings are rudimentary or absent); antennae moniliform. . . . . **Hemerobiidae.**
2. Radius of fore wings with only one sector; the cross-veins between costa and subcosta not branched, or at least not branched in basal half; antennae filiform; trichosors absent. . . . . **Chrysopidae.**

## Family HEMEROBIIDAE Westwood, 1840

Perkins, 1899:36.

Zimmerman, 1940:501.

## Brown Lacewings, Hemerobiids

This is the most diversified family of Neuroptera in Hawaii. There are 5 genera and 27 species recorded in this text (the Chrysopidae are represented by 2 genera and 24 species). Killington listed 9 genera and 28 species in Britain in 1936. Tillyard (1926:317) noted 16 species in Australia and only 4 in New Zealand. Fossil species have been found elsewhere in Oligocene strata.

Some of the most wonderful products of insular evolution are found in this family in Hawaii. Additional data on development of the group in our islands are given under *Nesomicromus* and its offshoot genera.

Our species range in size from about 6 mm. to 17 mm. in expanse of wings. All are brownish in color, marked with paler and darker shades and spots. Eyes large; no ocelli. Antennae long and moniliform. Prothorax broader than long. Fore and hind wings rather similar in shape; fore wings with not less than two radial sectors, the area between subcosta and anterior margin of wing with many branched cross-veins, and in some forms a sub-basal recurrent vein (humeral veinlet) which encloses a basal cell is present in this costal area; gradate series of cells elongate; wing membrane with microtrichia, veins with micro- and macrotrichia, wing margin with trichosors (small, thickened, marginal dots bearing setae) between ends of veins. Some of our endemic species are peculiar flightless forms with highly modified fore wings and whose hind wings are rudimentary or absent. In such forms, the venation may be difficult to trace.

The elongate-oval eggs are deposited on leaves and other parts of plants. They are not stalked, the micropyle is protuberant, and the surface may be sculptured.

The larvae break out of the egg with the aid of a saw-like egg-burster. In the first stage they have a trumpet-shaped empodium which is used as an adhesive organ. This type of empodium is similar to that found in all larval stages of the Chrysopidae, but it is lost after the first molt in the Hemerobiidae. In the second- and third-stage larvae the empodium is a pad-like organ. The larvae are rather similar in shape to those of the Chrysopidae, but are generally more slender. The derm is smooth, except for fine body hairs which are arranged in rows on the dorsum, and they lack the setose tubercles which characterize many chrysopid larvae. Also, they do not have modified, hooked or serrated, dorsal spines on the abdomen, and they do not carry a mass of debris on their backs as do many chryso-

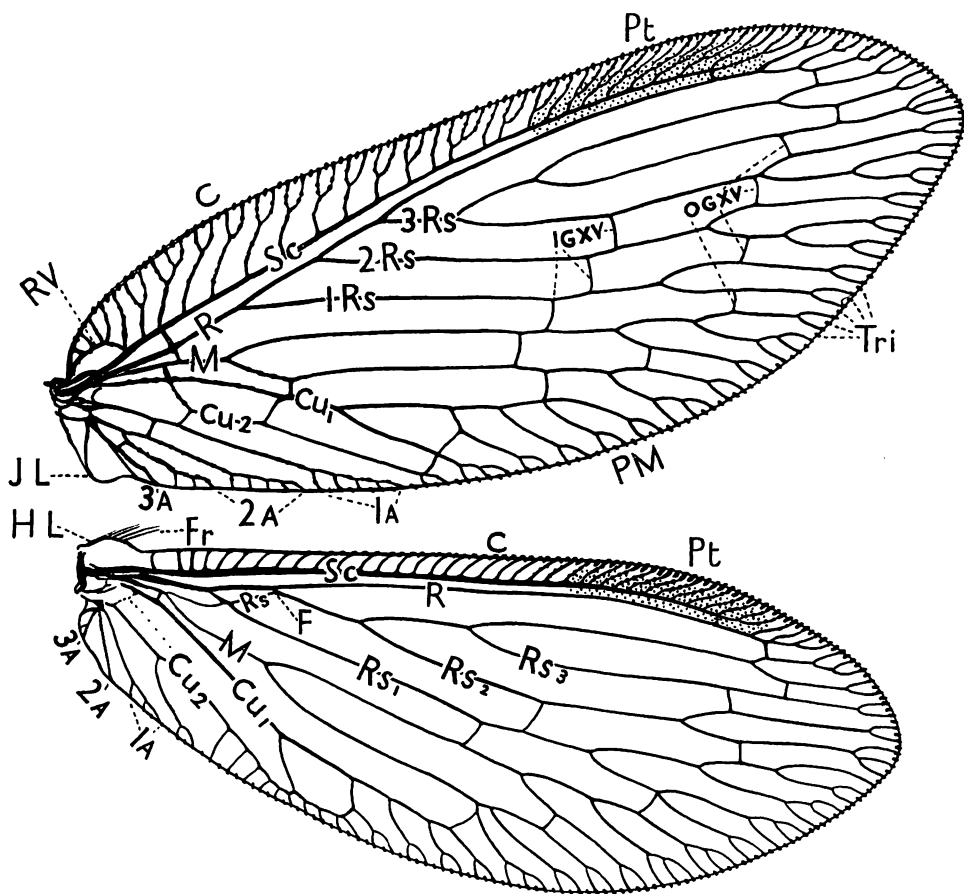


Figure 2—Wings of *Nesobiella hospes* (Perkins) with some of the parts, as used in this text, labeled. The setae have been omitted. C, costa; Cu<sub>1</sub> and Cu<sub>2</sub>, main branches of cubitus; F, false origin of Rs; Fr, frenulum; HL, humeral lobe; IGXV, inner gradate cross-veins; JL, jugal lobe; M, medius; OGXV, outer gradate cross-veins; PM, posterior margin; Pt, pterostigma; R, radius; Rs, radial sector; Rs<sub>1</sub>, Rs<sub>2</sub>, Rs<sub>3</sub>, first, second and third branches of radial sector; RV, recurrent humeral veinlet; Sc, subcosta; Tri, trichosors; 1A, 2A, 3A, first, second and third anal veins; 1Rs, 2Rs, 3Rs, first, second and third radial sectors.

pids. Each eye is six-faceted. Each antenna is inserted on a prominence between an eye and the base of a mandible; first segment small, second and third subequal, slender, the joint between them generally obscure; third segment terminating in a bristle. Mandibles elongate, but rather stout for the order, arcuate, about as long as, or longer than, the head. Labial palpi four-segmented. The articulation between the tibia and tarsus nearly fused; two simple tarsal claws present. Abdomen ten-segmented, with spiracles on the first eight segments. The caudal segment contains a two- or four-lobed, eversible adhesive organ.

Pupation takes place in a cocoon of loosely woven silk net (which is spun from the anus), through which the pupa may be seen resting within.

Withycombe (1923:526) wrote about the internal anatomy of the adults as follows:

The internal anatomy of the Hemerobiids . . . differs from other Neuroptera mainly in the following points. The salivary glands of the imago are simple, recurrent and tubular. Of the female cement glands, or homologues of those of Chrysopids, etc., one is tubular with a tuft of diverticula at its distal extremity. The other is simple though more or less dilated. . . . There are two globular accessory glands at the posterior end of each ovary, and ducts from these run into the oviducts. The testes of the male are separate, each enclosed in a yellow globular or kidney-shaped scrotum. They have, of course, separate vasa efferentia. The larval anatomy is typical.

There are eight Malpighian tubules with free posterior ends; the other six are attached to the hind gut.

The Hawaiian hemerobiids can readily be distinguished from all other Neuroptera found here simply at a glance. Their brown color and size serve as easy recognition characters. We have 27 species recorded in our fauna, 24 of which are endemic insects. Possibly a number of new species remain to be discovered.

Adult hemerobiids often feign death when disturbed, and when beaten or swept from vegetation this habit often leads to their being overlooked by collectors.

For some unknown reason, most of our Hemerobiidae are rare or very rare insects. A number of species have not been recaptured since Perkins collected the type series 60 years ago. I can offer no explanation for their rarity. There is plenty of food for them. Their rarity does not seem to be altogether a recent condition, because with all the concentrated work done by Perkins (who subsequently de-

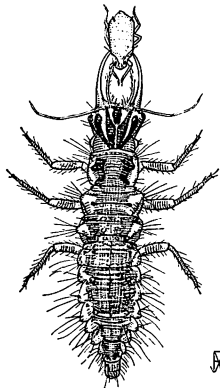


Figure 3—*Nesomicromus vagus* Perkins larva feeding on an aphid. (After Williams.)

scribed all of our native species, with the exception of the four described by me), he was able to amass a collection of only a few dozen specimens over a period of several years of concentrated, full-time collecting. Thirteen (59 percent) of the 22 species of *Nesomicromus* collected and described by Perkins were represented by unique specimens, and 77 percent of the species collected by him were represented by series of not more than four examples. Only five species were represented in his collection by a series of more than four examples each.

There are no aphids in our endemic fauna. Therefore, the Hemerobiidae, which elsewhere contains so many aphid-eaters that they are called "aphid-wolves" in some places, had to rely upon other food. It appears that psocids made up the bulk of their food. Psocids are among the most numerous of all insects in our forests. Our hemerobiids probably also fed originally on the young of other insects such as Heteroptera, psyllids and leafhoppers. Although we do not have any information regarding their feeding upon our endemic pseudococcids, it is possible that some of them did. Most of the species I have collected, however, have been found under conditions which have led me to believe that they preyed largely upon psocids, which are found in large numbers upon dead branches, dead fern fronds, or branches covered with mosses, lichens and liverworts. Perkins also was of the opinion that psocids were their chief prey. Some of our species, at least, have taken readily to the introduced aphids and feed greedily upon them. When I dissected certain types at the British Museum, I found masses of aphid remains in the alimentary tracts. In the type of *Nesomicromus vagus* Perkins, taken at Kau, Hawaii, in 1895, I found the remains of the black citrus aphid, *Toxoptera aurantii* (Boyer de Fonscolombe). This is the earliest known record for the species in Hawaii. It was not recorded as present in Hawaii until 1910 (see *Insects of Hawaii* 5:100, 1948).

#### KEY TO THE GENERA OF HEMEROBIIDAE FOUND IN HAWAII

1. Hind wings fully developed . . . . . 2
  - Hind wings atrophied and minute or absent; flightless species with modified fore wings . . . . . 4
- 2(1). Fore wings with an arched, recurrent humeral veinlet arising from near base of subcosta which does not extend out to costal margin but is recurved to root of wing, thus making a basal enclosed cell in costal area (fig. 2, RV) . . . . . 3
  - Fore wings without such a recurrent vein and thus lacking such a basal cell in costal area, the first cross-vein runs to costal margin . . . . . **Nesomicromus.**
- 3(2). Prothorax narrower than head; (antennae in our species conspicuously bicolored, basal third or more mostly black, remainder pale); fore wings with only two radial sectors, (the cell formed by recurrent vein in costal

area three times as long as broad in our species) . . . .

. . . . . **Symphherobius.**

Prothorax broader than head; (antennae in our species entirely yellowish); fore wings with three or four radial sectors, (the cell formed by recurrent vein in costal area only twice as long as high, or shorter, in our species) . . . . . **Nesobiella.**

4(1). Hind wings present, but reduced to small or minute and obscure, fleshy flaps; antenna longer than a fore wing . . . . . **Pseudopsectra.**

Hind wings absent; antenna shorter than a fore wing . . . . . **Nesothauma.**

#### Genus **SYMPHEROBIUS** Banks, 1905:40

This is the type genus of the family Sympherobiidae of some authors. I follow those workers who feel that the characters of *Symphherobius* are insufficiently divergent to make it desirable to separate it from, and give it equal rank to, the Hemerobiidae. The character used to separate *Symphherobius* and certain allied genera is that in the fore wings there are only two radial sectors and each is forked.

Our *Symphherobius* may easily be distinguished from all the other hemerobiids in Hawaii because of the combination of its sub-basal, recurrent vein in the costal area of the fore wing and its two, forked fore wing radial sectors.

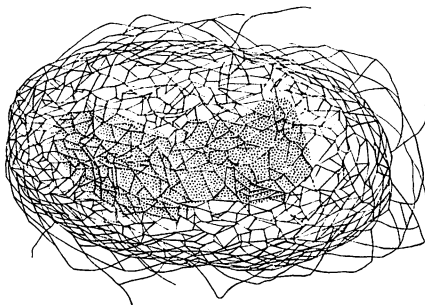


Figure 4—Cocoon of *Nesomicromus vagus* Perkins enclosing dried pupa.

#### **Symphherobius barberi** (Banks) (figs. 6, 7, 8, 11).

*Hemerobius barberi* Banks, 1903:241.

*Symphherobius barberi* (Banks) Banks, 1905:42. Zimmerman, 1940:502.

Barber's brown lacewing.

Kauai, Oahu, Maui, Hawaii, Johnston Island.

Introduced. This species was described from Arizona and California and was purposely introduced from Cuernavaca, Mexico, to Honolulu by E. W. Rust in 1929 and was first released in pineapple fields on Oahu. It is widespread in the southwestern United States and Mexico.



Hosts: it is a mealybug predator, and although it has only been recorded as preying upon *Pseudococcus adonidum* (Linnaeus) in Hawaii, it also feeds on certain other mealybugs. I found it preying upon an unidentified mealybug on asparagus fern in Honolulu in 1943.

I do not know of any records of the species having been purposely introduced to any island other than Oahu, yet I have seen examples from Kauai, Maui, and Hawaii, and during World War II it was found on Johnston Island, a coral island 700 miles from Honolulu.

Because it has a recurrent, sub-basal vein in the costal area of the fore wings, this species can only be confused with *Nesobiella* in our fauna. However, it is easily distinguished by the characters mentioned in the generic key. The bicolored antennae offer an easy method of recognizing the species in the field; they are mostly black in the basal third or more, and the remainder is yellowish. Excepting our flightless hemerobiids, this is the smallest hemerobiid found in Hawaii. It is only about 10 mm. in expanse, or about one-half the size of *Nesobiella hospes* (Perkins).

Genus **NESOBIELLA** Kimmins, 1935:618

This is a monotypic genus whose genotype is known only from Hawaii. We feel, however, that it may be a foreign element which was accidentally introduced to Hawaii but whose original home remains undiscovered. It has the characteristics of an immigrant insect and bears no relationship to any of our endemic lacewings. It is possible, however, that it is native.

The recurrent vein in the fore wing will distinguish this genus from all other hemerobiids in Hawaii excepting *Symphorobius barberi*. It is readily distinguished from *Symphorobius*, however, because it has three or four radial sectors instead of two, and its prothorax is broader than the head instead of being narrower than the head.

**Nesobiella hospes** (Perkins) (figs. 2, 6, 9, 10).

*Megalomus hospes* Perkins, 1899:36, figs. 1, 2, 16, 16a.

*Nesobiella hospes* (Perkins) Kimmins, 1935:618, figs. 10, 11. Zimmerman, 1940: 502. Type of *Nesobiella*.

Kauai, Oahu, Molokai, Maui, Hawaii (type locality: Kau, 4,000 feet).  
Immigrant? Source unknown.

I have no data on the food of this species.

Perkins (1899:37) said that it was "Found all over the group, in the mountains,

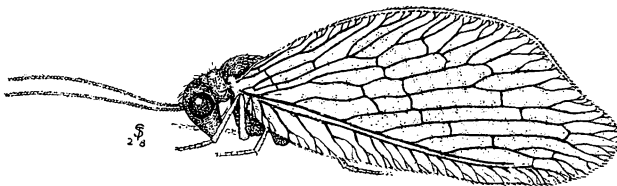


Figure 5—Sketch of lateral view of *Nesomicromus vagus* Perkins; only part of antennae shown. (After Williams.)

but not very abundant. This species has no relation with the rest of the Hawaiian Hemerobiidae, and I suspect it has been introduced." In 1913 (p. clxxi) he stated that

The single species referred to *Megalomus* is a rather common forest insect throughout the islands, the habits of which are very imperfectly known. It exhibits some rather remarkable variations, and though allied forms will, no doubt, be found elsewhere, it may itself prove to be endemic. We have not seen species from other countries having the same peculiarities of neurulation, which will no doubt exclude it from the genus *Megalomus* properly called. It flies at dusk and sometimes is attracted by lights in the nighttime, hiding by day amongst dead leaves attached to trees, and amongst dead fern-fronds. When beaten from these it feigns death like others of the group.

I have seen no records and have seen no specimens of this species from outside Hawaii.

#### Genus **NESOMICROMUS** Perkins, 1899:37

*Eumicromus* Nakahara, 1915:36. **New synonym.**

*Archaeomicromus* Krüger, 1922:171. Synonymy by Kimmins, 1936:88.

*Pseudomicromus* Krüger, 1922:172. Synonymy by Killington, 1937:257.

*Stenomicromus* Krüger, 1922:171. Synonymy by Killington, 1937:257.

Zimmerman, 1940:503.

The four fully developed wings, the anterior pair of which lack the recurrent vein and enclosed cell which is present on *Symphorobius* and *Nesobiella*, are characters which suffice in themselves to separate *Nesomicromus* from all the other Hawaiian Hemerobiidae.

*Nesomicromus* was long thought to be an endemic development of Hawaii, but Kimmins (1932:160) described *Nesomicromus marquesana* from the Marquesas. Esben-Petersen (1935:18) transferred Kimmins' species to *Archaeomicromus* and said, "Kimmins placed this species provisionally in the genus *Nesomicromus* Perkins, but it now has to be transferred to *Archaeomicromus*, which genus contains the second known Polynesian species, *A. navigatorum* Brauer." I believe that

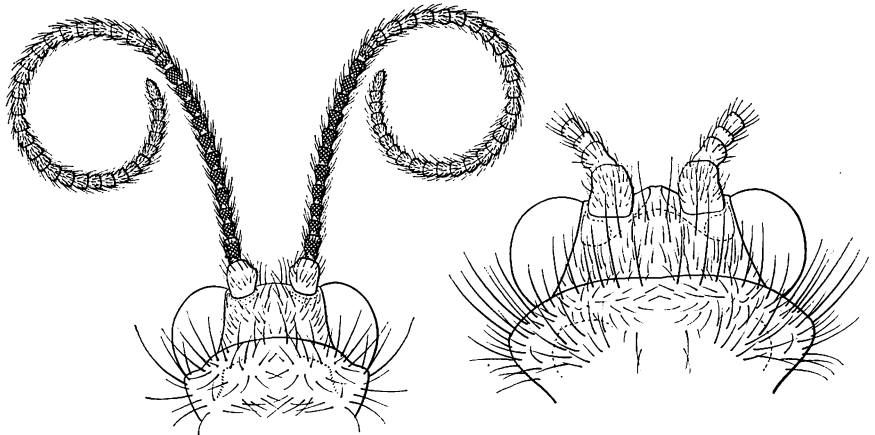


Figure 6—*Symphorobius barberi* (Banks), left. Pronotum, head and antennae to show bicolored antennae and pronotum narrower than breadth of head across eyes. *Nesobiella hospes* (Perkins), right, illustrating pronotum broader than head across eyes.

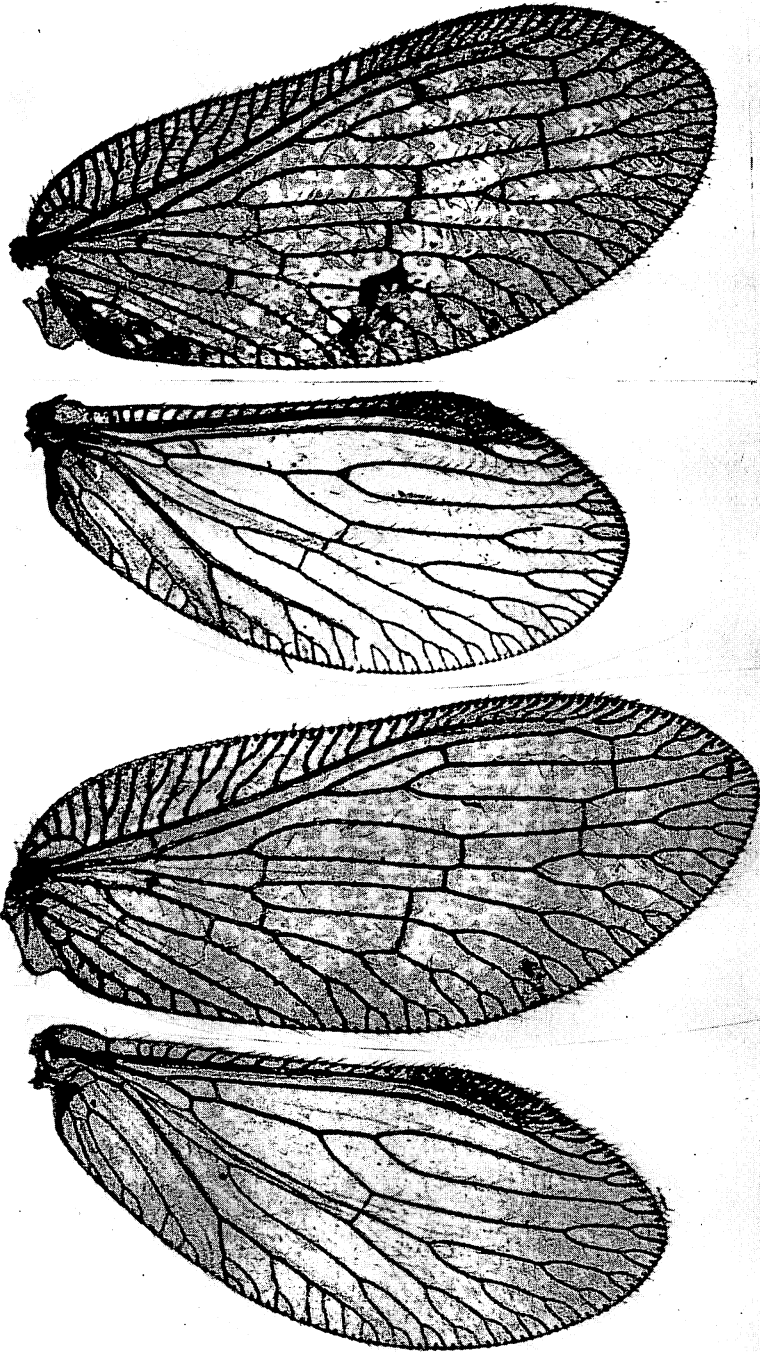


Figure 7—Wings of *Sympherobius barberi* (Banks). Upper pair from a specimen from Iao Valley, Maui; fore wing length, 4.8 mm. Lower pair from a specimen from Dallas, Texas; fore wing length, 4.4 mm.

Kimmins was right in assigning *marquesana* to *Nesomicromus*, and I cannot agree with Esben-Petersen that it can be maintained in a separate genus. I also am in complete agreement with the merging of *Archaeomicromus* with *Eumicromus*. As a result of the present survey, it is, moreover, essential to carry the synonymy further: I cannot find reason for maintaining the widespread *Eumicromus* separate from *Nesomicromus*, and both are here considered one genus. The facts that the group has flowered in Hawaii, and that some species have superficially diverged widely from type in so far as the shape of the wings is concerned, have led some authorities acquainted with only the more conservative continental species of the group to overlook the basic morphological similarities. The type of *Eumicromus* is *Micromus numerosus* Navás, designated by Nakahara (1915:36, pl. 1, fig. 6). When Nakahara erected the genus, he included six Japanese species. It has since been found that a number of other species belong with *numerosus* in *Eumicromus*, and today there are species from Eurasia, Africa, the Indo-Pacific and North America assigned to *Eumicromus*. I have not had an opportunity to revise the whole group of species, but I have seen species from Europe, Asia, Africa, the Indo-Pacific and North America which belong to the same genus as the Hawaiian species. I have also examined a few species now in *Eumicromus* which do not belong to this genus, but most of the species now in *Eumicromus* belong to *Nesomicromus*.

A number of the Hawaiian *Nesomicromus* have the posterior apical margins of the wings concave, and if wing shape were a generic character in this group, these species might be separated from the rounded-wing *Eumicromus* type on this character. But, as an examination of the figures will reveal, there is every intergrade from rounded-end wings to falcate and sinuous wings in the Hawaiian species, and wing shape is not a generic character here. Many years ago, when I first studied the Hawaiian Neuroptera, I was told that *Eumicromus navigatorum* could be separated generically from *Nesomicromus* because M in the fore wings

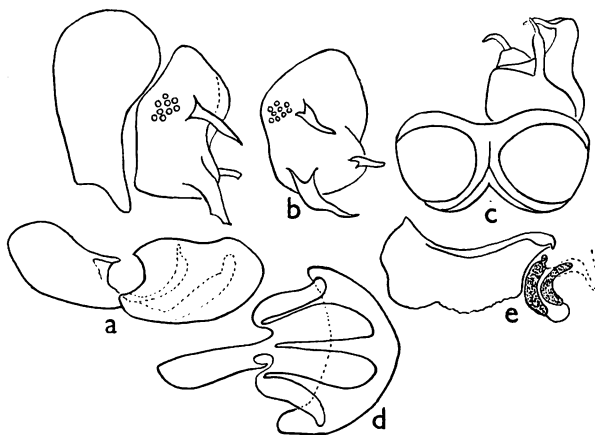


Figure 8—*Sympherobius barberi* (Banks), male genitalia. **a**, side view with parts separated, the tenth tergite (genital "valve") seen obliquely; **b**, valve more nearly in rear view; **c**, dorsal view with right valve omitted; **d**, dorsal view of ventral components of **a**; **e**, aedeagus complex. Setae omitted.

is closer to  $Cu_1$  than it is in species of *Nesomicromus*. In dry specimens of some *Eumicromus navigatorum* M is closer to  $Cu_1$  than it is on some examples of *Nesomicromus*, but the character is variable and has no generic value. On some dry, unmounted wings of *Eumicromus navigatorum*, the space between M and  $Cu_1$  near to where M forks is hardly greater than the breadth of a vein, and on most species of Hawaiian *Nesomicromus* the distance between these veins is nearly twice or more than twice the breadth of a vein, but the space between the veins is subject to variation. However, when the wing is mounted so that it can be examined properly, it will be revealed that the space between these veins on *Eumicromus navigatorum* is quite like that of various *Nesomicromus*.

Many years ago, Prof. Nathan Banks told me that he thought that because M in the fore wings of *Nesomicromus minimus* Perkins forks opposite to the second cross-vein between  $Cu_1$  and  $Cu_2$ , instead of before that cross-vein, *minimus* should go to the oriental *Nenus*. This character, if it were of real generic meaning, might be used to separate *minimus* from some of the other Hawaiian members of *Nesomicromus* on the basis of the few specimens of *minimus* known; but it is variable. This character cannot be used to separate *minimus* from *Eumicromus*

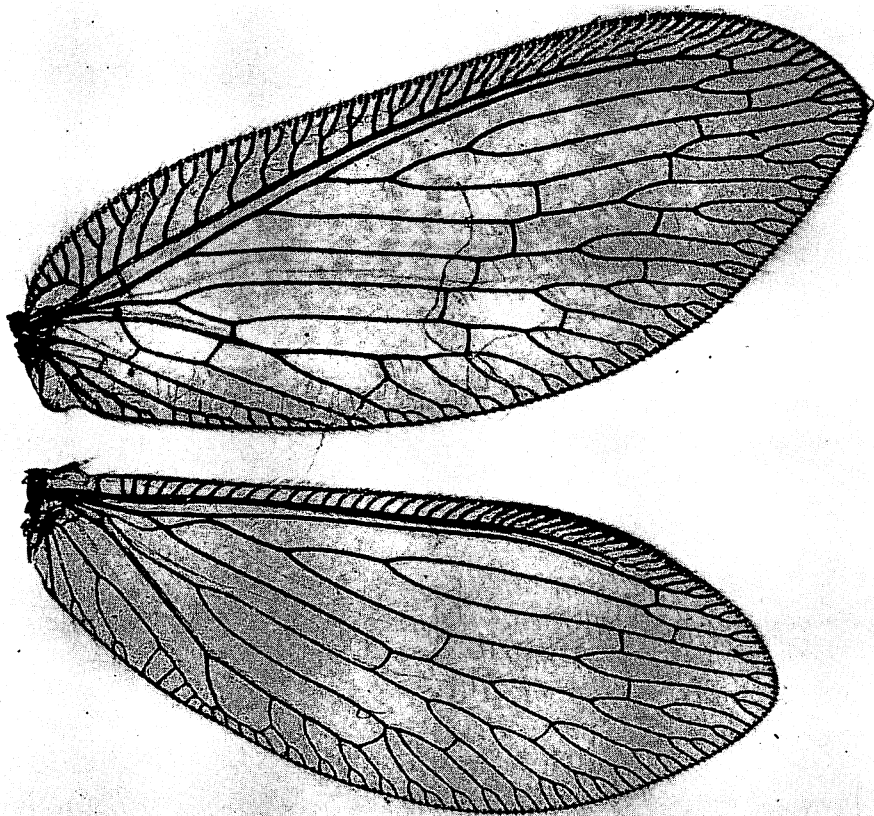


Figure 9—Wings of *Nesobiella hospes* (Perkins). National Park, Hawaii; fore wing, 9 mm.

*navigatorum*. I have examined a large series of *navigatorum* and have found much variation in the point of forking of M. On some examples it forks far basad of the second cross-vein between  $Cu_1$  and  $Cu_2$ , on others it forks near or opposite that cross-vein, and on others it forks beyond that cross-vein. I also examined a number of specimens of other Hawaiian *Nesomicromus*, and found that on some specimens of *rubrinervis* and on *minimus* and *paradoxus*, M forks opposite the second cross-vein between  $Cu_1$  and  $Cu_2$ . On some specimens of *rubrinervis*, and on *angularis*, *angustipennis*, *bellulus*, *brunnescens*, *distinctus*, *drepanoides*, *falcatus*, *forcipatus*, *fulvescens*, *haleakalae*, *infumatus*, *latipennis*, *longispinosus*, *minor*, *molokaiensis*, *ombrias*, and *stenopteryx* M forks basad of the second cross-vein between  $Cu_1$  and  $Cu_2$ . In this second group, there is much variation in the point of forking of M. In *stenopteryx* (available material, that is) there is no cross-vein in the right wing, but in the left wing the cross-vein is partly developed and M forks at only about twice the breadth of a vein basad of the cross-vein. At the other extreme is *drepanoides* and *brunnescens* where M forks nearer to the first cross-vein between  $Cu_1$  and  $Cu_2$  than to the second cross-vein. In some examples of some species there are one or two extra cross-veins at the position of the first cross-vein, and these should not be confused with the true second cross-vein. In the hind wings the number of cross-veins between R and  $R_s$  is subject to considerable variation. Such characters are not of generic value.

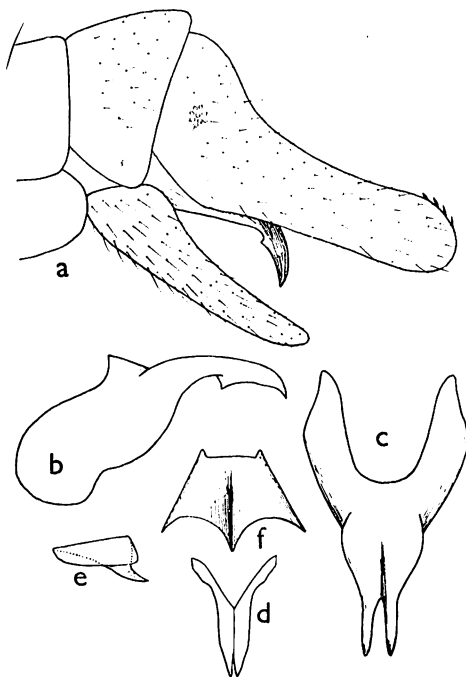


Figure 10—*Nesobiella hospes* (Perkins), male genitalia. **a**, lateral view of apex of abdomen; **b**, tenth sternite, lateral; **c**, tenth sternite, dorsal; **d**, parameres, ventral; **e**, hypandrium, lateral; **f**, hypandrium, dorsal. (After Kimmins.)

The generic classification of the Hemerobiidae is unsatisfactory from the world standpoint, and many "genera" seem to me to be founded on poor or variable characters. Some species have such variable venation that various individuals of the same species might be placed in different genera, and the right sides of some examples may fit one genus and their left sides another genus.

It is, however, when we examine the genitalia that we can most appreciate resemblances and differences in many Hemerobiidae. The differences displayed by the Hawaiian species are usually excellent for differentiation of the species, as the illustrations demonstrate. The gulf between the type of genitalia possessed by our *Nesomicromus* and such obviously different genera as *Symphorobius* and *Nesobiella* is striking. The basic pattern of the male genitalia is closely similar in all of the Hawaiian species of *Nesomicromus*, and there are extra-Hawaiian species whose genitalia fit very closely the Hawaiian pattern. The male genitalia of *Eumicromus navigatorum*, however, may appear at first sight to be farther separated from the Hawaiian group than they really are. This is principally because the ventral processes of the lateral valves are heavier and more strongly sclerotized than in our endemic Hawaiian species, and these processes remain bent inward even after treatment with potash. In contrast, processes of the Hawaiian species are less strongly sclerotized and although they are bent inward and crossed in life, much as in *navigatorum* but to a lesser degree, they become more flexible when treated with potash and can be extended straight back. The genitalia of *navigatorum* are perhaps at the extreme opposite of the genus to those of the Hawaiian species, and there is an intergradation between these two extremes. The Marquesan and some of the Oriental and American species I have examined are very much more like the Hawaiian species than is *navigatorum*. After studying the genitalia of a number of species, I have no doubt that the synonymy of *Eumicromus* and *Nesomicromus* is correct. If there were two genera involved, I would expect that obvious divergence in type of genitalia would be evident, just as there is between the good genera *Symphorobius* and *Nesobiella* (compare the illustrations).

It is fortunate that all but one of the species of Hawaiian *Nesomicromus* were described by Perkins—all but three of them in one paper. If several authors had described various species at different times, our literature would probably be cluttered with unnecessary and meaningless generic names. It is understandable that the extreme forms of wing shape and variable number of radial sectors would lead authors to erect more than one genus for the group if they were unfamiliar with the entire complex and its radiations. Perkins (1899:37) noted that "The wings are either rounded at the apex, or falcate, somewhat resembling *Drepanopteryx* [*Drepanepteryx*], the one form passing gradually into the other, so that the species cannot be subdivided on this character, although the extreme forms are vastly different. The species with simply rounded wings can (so far as I can see) only be separated from *Micromus* by the length of the joints of the maxillary palpi, in which they also agree with the species which have falcate wings. The penultimate joint of these palpi is very short, being only about half as long as the terminal." Perkins also noted that the male terminalia "are very similar through-

out the genus, the appendices being rarely very conspicuous, usually of triangular form and pointed at the apex. In all the species they give off each from their lower margin towards the base a fine spine, and slight differences in the length, form, etc. of these spines furnish useful specific characters. [Compare the illustrations in this text.] The general similarity in the form of the appendices, which extends also to the two following genera [that is, to *Pseudopsectra* and *Neso-*

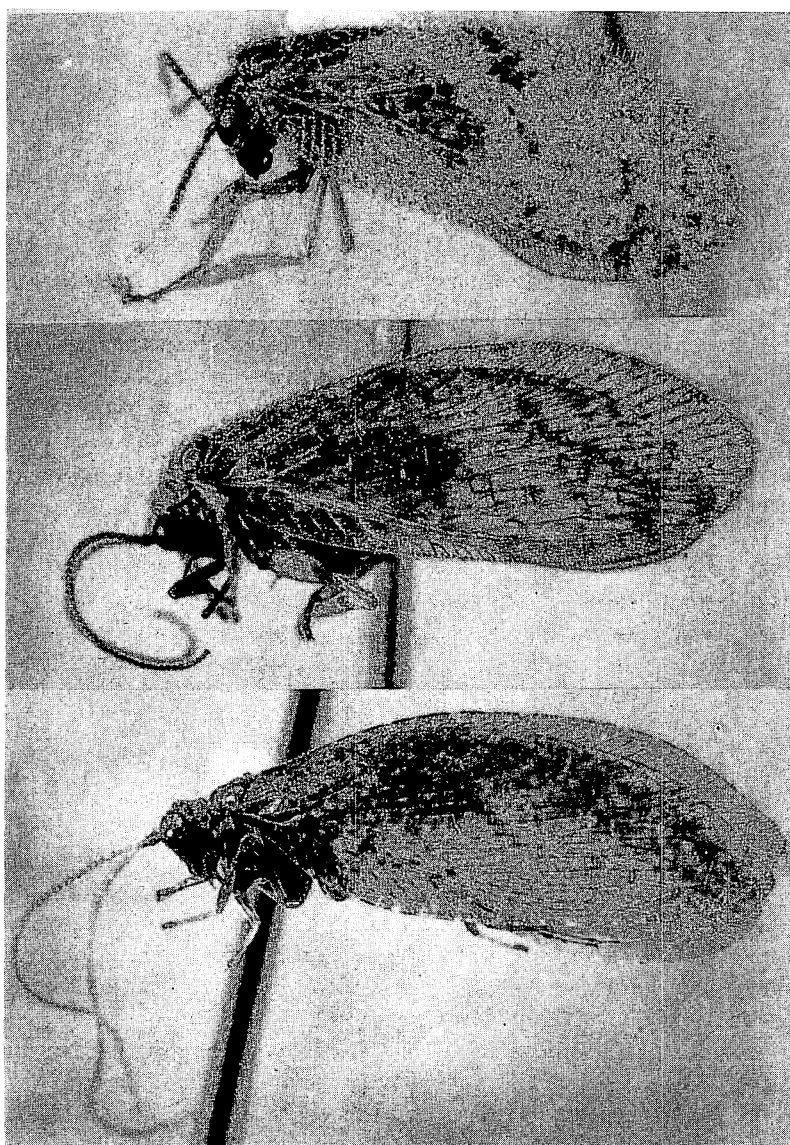


Figure 11—*Sympherobius barberi* (Banks), top. Honolulu; length, 5 mm. *Nesomicromus navigatorum* (Brauer), middle. Honolulu; length, 8 mm. *Nesomicromus brunnescens* Perkins, bottom. Kula Pipe Line, Maui, 4,200 feet; length, 7 mm. All lengths exclude antennae.



*thauma*], is very remarkable." Perkins knew the animals in the field, and he did not consider that more than one genus is involved in Hawaii.

The range of variability in the number of radial sectors in the fore wing is noteworthy. The usual number is five or six, but there may be only three, as in some examples of *minimus*, or as many as nine, as in some *brunnescens*. There may often be more sectors in one wing than in the other wing of the same specimen. Caution must be used when counting the radial sectors, because it is easy to confuse M with the radial series and count it as the first radial sector.

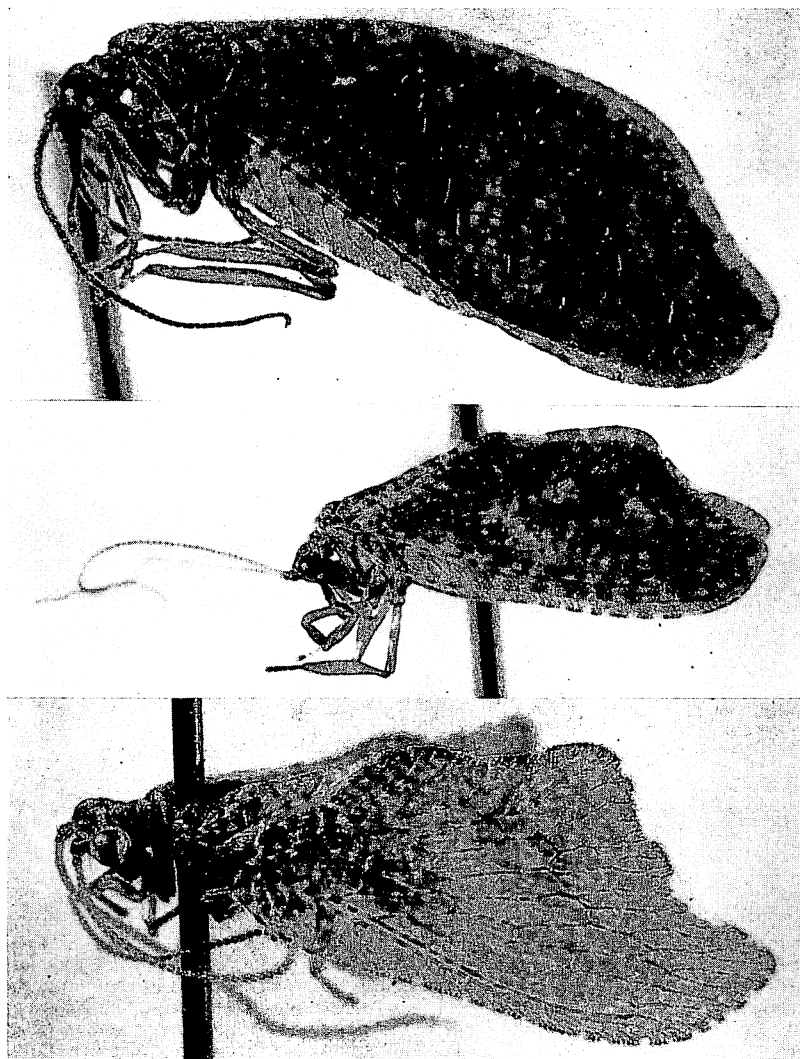


Figure 12—*Nesomicromus vagus* Perkins, top. Kaunuohua Ridge, Kauai, 4,000 feet; length, 8 mm. *Nesomicromus drepanoides* Perkins, middle. Waiakoali Valley, Kauai, 3,700 feet; length, 7 mm. *Nesomicromus falcatus* Zimmerman, bottom. Allotype female; Waiahole, Oahu; length, 7.5 mm. All lengths exclude antennae.

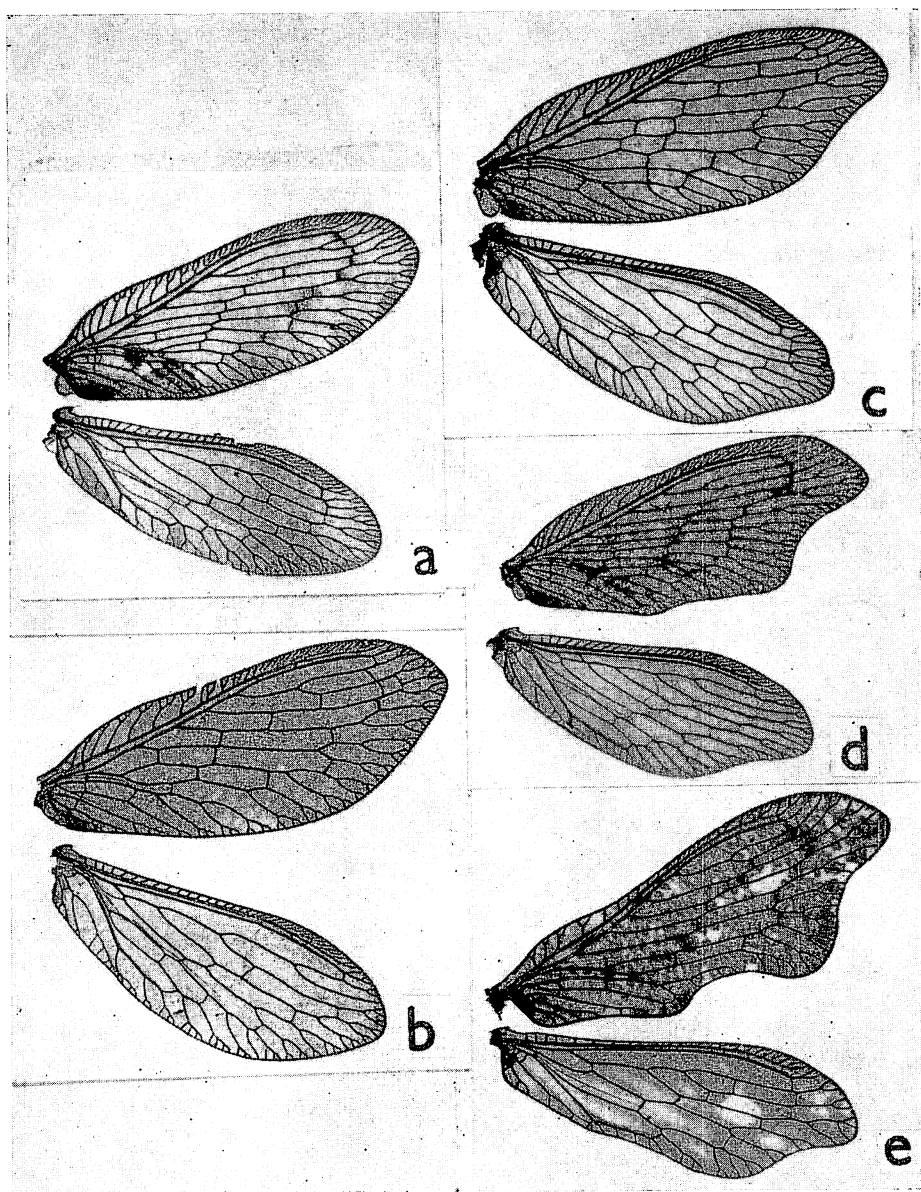


Figure 13—A plate of photographs of the wings of *Nesomicromus* species to illustrate the intergradation in shape from simple convex margins to strongly sinuous margins. **a**, *bellulus* Perkins, holotype; **b**, *subochraceus* Perkins, holotype; **c**, *vagus* Perkins, holotype; **d**, *drepanoides* Perkins, holotype; **e**, *paradoxus* Perkins. (Each of these figures is shown enlarged in the section describing the respective species.) Some workers suggest that **a** and **e** represent different genera, but their conclusions are based on superficial study. If **a** and **e** are placed in different genera, than what is to be done with the intergrades **b**, **c** and **d**? The genitalia of these species differ only in minor specific characters; the other features of the body and appendages are all generically similar. The wing venation is highly variable, and the right and left wings of the same individual may have different venations.

The holotypes of the species described by Perkins in his "Supplement to the Neuroptera" in *Fauna Hawaiiensis* (1910:691–696), *angularis*, *ombrias* and *phaeostictus*, are now in Bishop Museum. The holotypes of the nineteen species described in his 1899 *Fauna Hawaiiensis* monograph are in the British Museum.

The original food of *Nesomicromus* appears to have been predominantly psocids, and most species are usually found where psocids are abundant. No doubt other insects, such as young leafhoppers, are also eaten. There were no aphids in the original Hawaiian fauna, but when aphids were introduced following the discovery of the islands by Captain Cook near the close of the eighteenth century, at least some *Nesomicromus* took to eating them with relish. When I dissected some of the types at the British Museum, which had been collected by Perkins in the 1890's, I found their intestines crammed with aphid remains. As noted earlier in this chapter, it was in the intestine of the type of *Nesomicromus vagus* that I found the earliest known Hawaiian specimens of the black citrus aphid, *Toxoptera aurantii*. We do not know that all species of *Nesomicromus* have taken to eating introduced aphids as has *vagus*. *Nesomicromus minimus* and *fulvescens*, in addition to *vagus*, are known to feed upon aphids, however. Perkins found these three species most abundant, and he thought that the greater number of members of these species was linked to their feeding upon the great abundance of introduced aphids. He noted (1913:clxxi) that "*vagus*, the most successful of all the species, now sometimes abounds outside the forest in fields of sugar-cane attacked by *Aphis sacchari*,

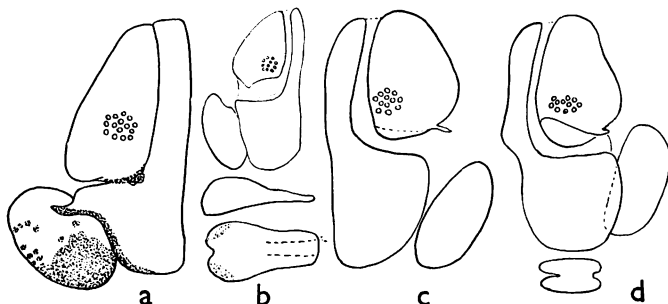


Figure 14—Female terminalia of *Nesomicromus*. **a**, *navigatorum* (Brauer); **b**, *fulvescens* Perkins, holotype, with sternite shown in lateral and ventral view; **c**, *latipennis* Perkins, sternite omitted, holotype; **d**, *vagus* Perkins, sternite in ventral view.

on maize, etc., and in the mountains we have found it in enormous numbers on the rare tree *Gossypium drynarioides* infested by *Aphis gossypii*. On one occasion the capsules of the latter plant were found full of the cocoons of *N. vagus*, the larvae having crept within for the purpose of pupation."

It is noteworthy that this fine group of interesting Hawaiian endemics has received so little attention, but I believe that one reason for this is perhaps because it has been too difficult to identify the species heretofore. I have seen a number of examples which have been misnamed. In addition to the contributions made by Perkins, and until my preliminary review in 1940, I have been able to find in our literature only one reference to *brunnescens* and a half dozen references

to the common *vagus*. The other species have not been mentioned, and few examples have been assembled in collections. Usually, when an adult is swept or beaten from vegetation, it will feign death and lie quiescent among the plant debris in the net where it is very easily overlooked or mistaken for a fragment of bark or a dead leaf. Perhaps this habit is partly responsible for the few specimens collected, but many of the species do seem unexplainably rare.

I regret very much not being in a position to supply information about the early stages of our species. I have written most of this text away from Hawaii, and as I am no longer a resident of the Islands I cannot procure the needed material or make observations of the living animals in the field.

The species of endemic *Nesomicromus* have the following distributions as I know them now:

	Total
Species confined to Kauai: <i>angustipennis</i> , <i>drepanoides</i> , <i>forcipatus</i> .....	3
Species confined to Oahu: <i>falcatus</i> , <i>fulvescens</i> , <i>ombrias</i> .....	3
Species confined to Molokai: <i>distinctus</i> .....	1
Species confined to Maui: <i>bellulus infumatus</i> , <i>haleakalae</i> .....	2
Species confined to Hawaii: <i>latipennis</i> , <i>longispinosus</i> , <i>rubrinervis</i> .....	3
Species found on two islands: <i>minimus</i> (Molokai, Hawaii), <i>paradoxus</i> (Molokai, Hawaii).....	2
Species found on three islands: <i>angularis</i> (Oahu, Molokai, Lanai), <i>bellulus</i> (Oahu, Molokai, Maui), <i>brunnescens</i> (Molokai, Maui, Lanai).....	3
Species found on four islands: <i>subochraceus</i> (Oahu, Molokai, Maui, Hawaii).....	1
Species found on six islands: <i>vagus</i> (Kauai, Oahu, Molokai, Maui, Lanai, Hawaii).....	1
Species found on Kauai: <i>angustipennis</i> , <i>drepanoides</i> , <i>forcipatus</i> , <i>vagus</i> .....	4
Species found on Oahu: <i>angularis</i> , <i>bellulus</i> , <i>falcatus</i> , <i>fulvescens</i> , <i>ombrias</i> , <i>subochraceus</i> , <i>vagus</i> .....	7
Species found on Molokai: <i>angularis</i> , <i>bellulus</i> , <i>brunnescens</i> , <i>distinctus</i> , <i>paradoxus</i> , <i>subochraceus</i> , <i>vagus</i> .....	7
Species found on Maui: <i>bellulus</i> , <i>bellulus infumatus</i> , <i>brunnescens</i> , <i>haleakalae</i> , <i>subochraceus</i> , <i>vagus</i> .....	6
Species found on Lanai: <i>angularis</i> , <i>brunnescens</i> , <i>vagus</i> .....	3
Species found on Hawaii: <i>latipennis</i> , <i>longispinosus</i> , <i>minimus</i> , <i>paradoxus</i> , <i>rubrinervis</i> , <i>subochraceus</i> , <i>vagus</i> .....	7

I have not seen any specimens from the Leeward Hawaiian Islands, but I should expect that a few species might be found on the higher islands there, although conditions may not be favorable for the genus on those islands now.

One of the main difficulties I have had to face while preparing this text is the

lack of adequate material. Series of almost all the species are needed to elucidate the range of variation and distribution.

# KEY TO THE SPECIES OF HAWAIIAN NESOMICROMUS

1. Posterior ("dorsal") preapical margins of fore wings distinctly concave, wing falcate (as in figure 13, c, d, e).....2
- Posterior ("dorsal") preapical margins of fore wings convex, or straight, never distinctly concave, wing not falcate (as in figure 13, a, b).....7
- 2(1). Posterior ("dorsal") margins of fore wings shallowly or deeply sinuous, before apical third of wing (as in figure 13, d, e).....3
- Posterior ("dorsal") margins of fore wings arcuate and not sinuous from base to the preapical concavity (figure 13, c).....5
- 3(2). Posterior margin of fore wing deeply concave in middle third of length of wing (as in figure 13, e); Molokai, Hawaii.....**paradoxus** Perkins.
- Posterior margin of fore wing only shallowly concave in middle third of wing (as in figure 13, d).....4
- 4(3). Fore wing distinctly more than twice as long as its

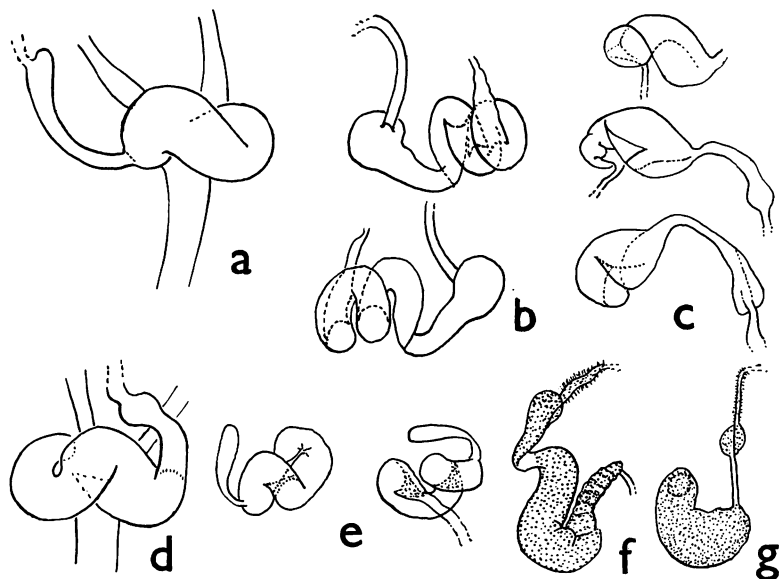


Figure 15—Some spermathecae of *Nesomicromus*. **a**, *drepanoides* Perkins (this is from the same aspect as **d**, but note that one spermatheca is dextral and the other sinistral); **b**, *bellulus* Perkins, holotype, the lower figure is from the opposite side to the upper figure; **c**, three different views of *haleakalae* Perkins, holotype; **d**, *vagus* Perkins; **e**, *bellulus infumatus* (Perkins), opposite sides; **f**, *fulvescens* Perkins, holotype; **g**, *latipennis* Perkins, holotype.

- greatest breadth, cells between first three radial sectors not much if any broader than greatest space between Sc and R; cells between first, second and third radial sectors between inner and outer gradate cross-veins shorter than distance between outer gradate cross-veins and wing margin; pterostigmata pink or pinkish in mature examples; Kauai. . . . .
- .....**drepanoides** Perkins.
- Fore wing about twice as long as greatest breadth, cells between first three radial sectors obviously broader than distance between Sc and R; cells between first, second and third radial sectors between inner and outer gradate cross-veins longer than distance between outer gradate cross-veins and wing margin; pterostigmata not pink; Oahu. . .**falcatus** Zimmerman.
- 5(2). Gradate cells of fore wings narrow, cell between first and second radial sectors only about as broad (at its greatest subapical breadth) as distance between Sc and R at origin of this cell; a narrow-winged, pink-tinged (when mature) species from Kauai. . . . .
- .....**angustipennis** Perkins.
- Gradate cells not so narrowed. . . . .6
- 6(5). Wings (excluding vein coloring) not spotted or banded but nearly uniformly brown over all, or with small maculae, but never with large patches of contrasting color; hind wings embrowned; fore wings moderate in breadth, as illustrated, extreme breadth divided into length equals about 2.5 or more; the most common species on all the islands, with much variation in size and color. . . . .**vagus** Perkins.
- Wings not nearly uniformly brown over all, but both pairs distinctly maculate with large dark and pale areas; hind wings hyaline where not maculate; fore wings very broad, as illustrated, greatest width divided into length equals only about 2.1 or 2.2; Oahu, Molokai, Lanai. . . . .**angularis** Perkins.
- 7(1). Costal margin of fore wing conspicuously and comparatively strongly sinuate, as in figure 33; a broad-winged species from Oahu. . . . .**ombrias** Perkins.
- Costal margin of fore wing beyond basal arching slightly convex or nearly straight or only slightly concave and thus very slightly sinuous, but never as in figure 33 of *ombrias*. . . . .8
- 8(7). Very broad-winged species; fore wings as in figures 27, bottom, and 29, their hind margins not gently arcuate

- from base to apex, but very strongly convex . . . . . 9
- Fore wings narrow to medium in breadth, their hind margins never very strongly convex as in *fulvescens* and *latipennis* . . . . . 10
- 9(8). Last (fifth, usually) sector of radius of fore wing arising before middle of wing, the cells thus long and narrow between the sectors, as in figure 27; Oahu . . . . . **fulvescens** Perkins.
- Last sector of radius in fore wing arising far distad of middle of wing; the cells thus very broad between the sectors, as in figure 29; Hawaii . . **latipennis** Perkins.
- 10(8). Fore wings with outer, and sometimes most of inner, row of gradate cross-veins *not* forming a continuous or nearly continuous, zig-zag course across wing, but interrupted as in figure 31; normally with only four radial sectors, a rare example with three or five . . . . . 11
- Fore wings with outer and inner rows of gradate cross-veins, with some variation, mostly forming distinct zig-zag courses across the wing, the outer series usually continuous or nearly so between first to last sector, and most often with darker color marking the zig-zag courses; radius normally with five to seven sectors, except for *forcipatus* which has four, otherwise only a rare individual with as few as four sectors . . 13
- 11(10). Fore wing moderately broad, extreme width divided into length equals about 2.5; Oahu, Molokai, Maui, Hawaii . . . . . **subochraceus** Perkins.
- Fore wing obviously narrow, extreme width divided into extreme length equals about 2.9 . . . . . 12
- 12(11). Anterior and posterior wing margins obviously dissimilar subapically, the posterior margin straighter before apex than the anterior margin, as in figure 36; Hawaii . . . . . **rubrinervis** Perkins.
- Anterior and posterior wing margins subequally curved into apex, as in figure 31; Hawaii . . **minimus** Perkins.
- 13(10). Holotype male (the only example known) a small (11 mm.), pale species (possible teneral) with only four radial sectors in fore wing; antennae (segments not individually darkened distad), head, body and legs pale, subtestaceous, fore tibiae not banded; fore and hind wings tinged with pink and veins partly pink; valve of male genitalia large and unusual in form, with the ventral process reduced to a seta, as in figure 18, a; Kauai . . . . . **forcipatus** Perkins.
- Not such species . . . . . 14

- 14(13). Setae on radial sectors of fore wings very short to microscopic, the longest setae at most hardly twice the breadth of a vein.....15
- Setae on radial sectors of fore wings usually long and bristling; if inconspicuous, at least some are always several times as long as the breadth of a vein; some species have most of the setae short and rather inconspicuous, but these are intermixed with at least some long setae.....17
- 15(14). Fore wing with outer row of gradate cross-veins between branches of M and Cu<sub>1</sub> separate from those between radial sectors and appearing as a separate row between the inner and outer gradate series; five radial sectors; cells broad; M with only one fork before gradate cross-veins; Molokai. **distinctus** Perkins.
- Fore wing with gradate cross-veins forming unusually long, continuous or nearly continuous rows across wing, cross-veins in the outer series between branches of M and Cu<sub>1</sub> continuous with those in radial sector field; six to nine radial sectors; cells narrow; M forked twice before gradate cross-veins, the second fork placed near, or basad of, second cross-vein between Cu<sub>1</sub> and Cu<sub>2</sub>.....16
- 16(15). Ventral process of male genital valve unusually long and projecting far beyond apex of valve, as in figure 18, g; hind wing with four branches to Rs and with one or more cross-veins between R and Rs near or beyond third fork and before fourth fork (in two examples seen; character may be variable); Hawaii.....**longispinosus** Perkins.
- Ventral process of male genital valve not of unusual form, as in figure 17, a; hind wing with five branches

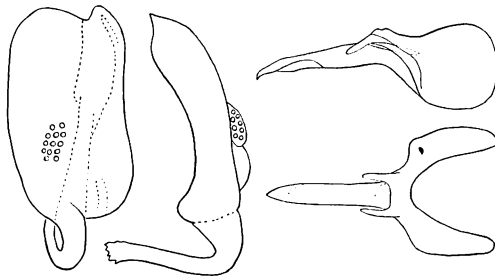


Figure 16—*Nesomicromus navigatorum* (Brauer), male genitalia. Lateral and caudal view of "valve" (ninth and tenth tergites), and lateral and dorsal views of tenth sternite and aedeagus. The ventral process of the tenth tergite is stiffer and more heavily sclerotized in this species than in our endemic species, and, even when treated in KOH, it does not become flexible enough to lie out flat with the longitudinal body axis.



to Rs and without any cross-veins between R and Rs beyond second and fourth forks of Rs (in several examples studied); Molokai, Maui, Lanai, Hawaii. . .

.....**brunnescens** Perkins.

- 17(14). Tibiae pale, not banded; fore wing membrane almost without dark marking, the dark coloring confined to veins and cross-veins; hind wing with six (usually) or five branches to Rs, gradate cross-veins arranged as illustrated, hairs on veins dense and very conspicuous and giving the wing an almost fuzzy appearance; a pale brown species with intensely iridescent wings and most common in lowland and agricultural areas. . . . .**navigatorum** (Brauer).

Tibiae with conspicuous dark bands; fore wing membrane with conspicuous dark maculae or extensively infumate and maculate; hind wings with only four (usually) or three branches to Rs, hairs on veins comparatively sparse, although long and distinct, and not giving the hind wing a fuzzy appearance; dark bodied species with obviously maculate fore wings and confined to mountain regions. . . . .18

- 18(17). Penultimate segment of maxillary palpus comparatively long and slender, about three times as long as broad; wings as illustrated, posterior margins straight or nearly so before entering apex so that the arcuation appears flattened there and the contours of costal and posterior margins are subapically different; Maui (figure 28) . . . . .**haleakalae** Perkins.

Penultimate segment of maxillary palpus comparatively short and broad, not or hardly twice as long as broad; wings with posterior margins more continuously arcuate and not preapically flattened, and costal and posterior margins more nearly similar, as in figures 22, 23. . . . .19

- 19(18). Fore wings conspicuously marked with variable, contrasting pale and infusate areas; hind wings with two or three distal branches of Rs pale between the inner and outer series of gradate cross-veins, and wing membrane pale in this area and not infumate as surrounding areas; Oahu, Molokai, Maui. . . . .

.....**bellulus bellulus** Perkins.

Fore wings more nearly uniformly infusate and with a restricted number of pale spots; hind wings mostly uniformly infusate and without a pale area between the inner and outer gradate cross-veins across the

distal two or three branches of Rs, but all branches of Rs uniformly dark; Maui. . . . .  
 . . . . . **bellulus infumatus** (Perkins).

**Nesomicromus angularis** Perkins (figs. 17, n-o; 20).

*Nesomicromus angularis* Perkins, 1910:691.

*Nesomicromus phaeostictus* Perkins, 1910:692. **New synonym.**

Endemic. Oahu (type locality of *phaeostictus*: "Waialua District 1500 ft.," Koolau Range), Molokai (type locality of *angularis*: "nearly 5000 ft."), Lanai.

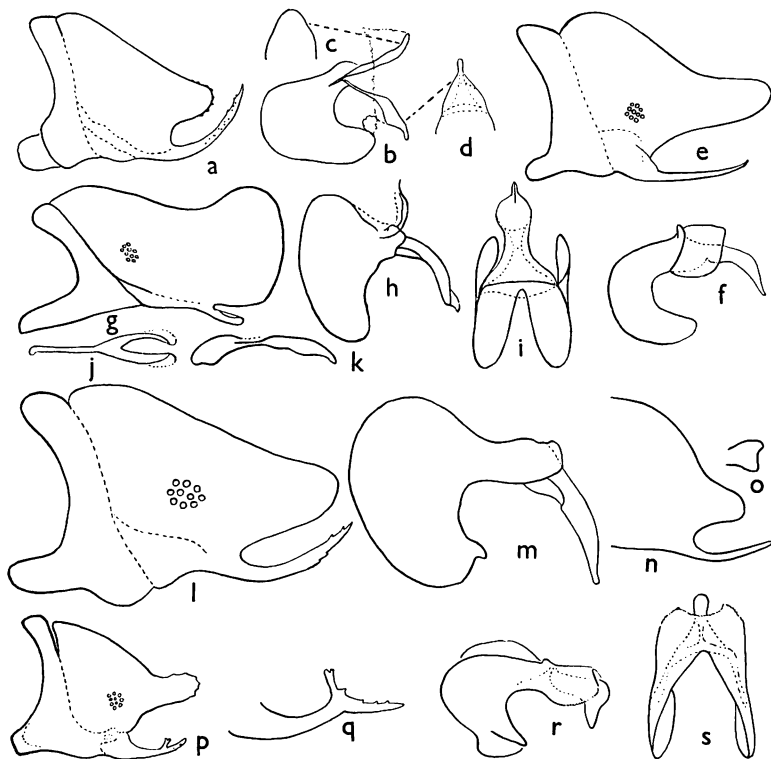


Figure 17—*Nesomicromus*, male genitalia. **a-d**, *brunnescens* Perkins, holotype: **a**, lateral view of valve (trichobothria omitted by oversight); **b**, lateral view of tenth sternite and aedeagus; **c**, dorsal view of dorsal part of tenth sternite, as noted; **d**, dorsal view of apical part of aedeagus. **e-f**, *bellulus* Perkins, type: **e**, lateral view of valve; **f**, lateral view of tenth sternite and aedeagus. **g-k**, *distinctus* Perkins: **g**, valve; **h**, **i**, lateral and dorsal views of tenth sternite and aedeagus; **j**, **k**, dorsal and lateral view of parameres. **l-m**, *drepanoides* Perkins, holotype: **l**, valve; **m**, tenth sternite and aedeagus. **n-o**, *angularis* Perkins, holotype: **n**, valve, trichobothria omitted; **o**, apex of aedeagus. **p-s**, *falcatus* Zimmerman, holotype: **p**, valve (ventral process apically foreshortened because it curves mesad); **q**, enlarged, more ventral view of ventral process of valve; **r**, **s**, lateral and dorsal views of tenth sternite and aedeagus. Some individual variation in the shape of the valves can be anticipated. Also, the number and size of the denticles on the ventral process of the valve varies. Where the denticles are very small they have not always been indicated in these outline sketches. The numerous setae have been omitted. In life, the ventral processes of the valves usually bend obliquely mesad and often the two processes are crossed.

I found, upon examining the types of *angularis* and *phaeostictus* in Bishop Museum, that *phaeostictus* is only a pale female of *angularis*, and the new synonymy is necessary.

The record from Lanai is new and is based upon a female taken by G. Munro, "ex Pua" [*Olea sandwicensis*], in the forest on the northeast side of the island, November 22, 1916. It has a color pattern more like the type of *phaeostictus* than the type of *angularis*. These types have seven radial sectors in the fore wings, but the Lanai specimen has eight sectors.

***Nesomicromus angustipennis* Perkins (fig. 20).**

*Nesomicromus angustipennis* Perkins, 1899:38, pl. 4, fig. 5.

Endemic. Kauai (type locality: "Mountains of Kauai 4000 ft.").

In his original description, Perkins said that this was "Closely allied to *N. hawaiiensis*. . . ." What he meant was *vagus*. Perhaps *hawaiiensis* was a manuscript name later discarded in favor of *vagus*. This species is rather easily confused

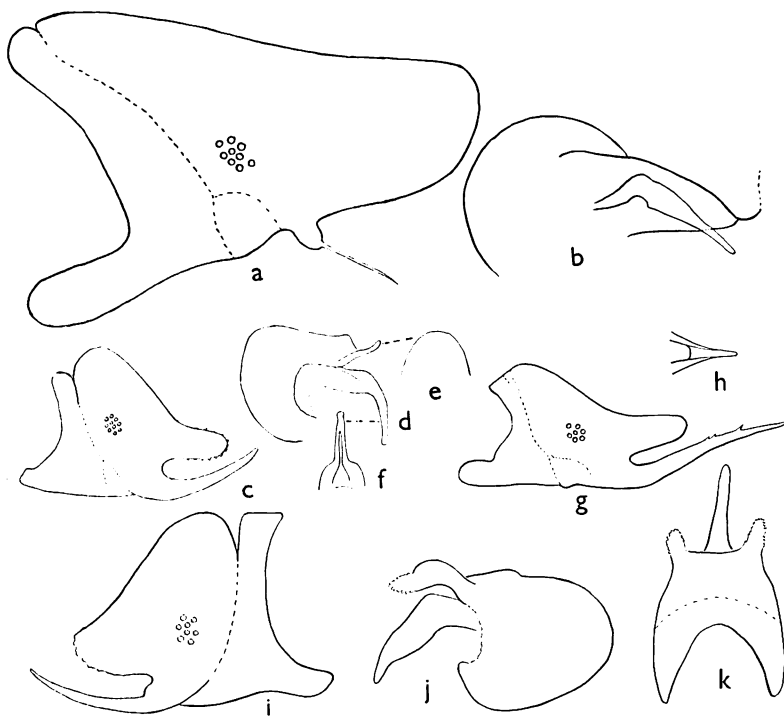


Figure 18—*Nesomicromus*, male genitalia. a-b, *forcipatus* Perkins, holotype: a, valve; b, tenth sternite and aedeagus. c-f, *haleakalae* Perkins: c, valve; d, lateral view of tenth sternite and aedeagus; e, dorsal view of apex of dorsum of tenth sternite; f, dorsal view of aedeagus. g-h, *longispinosus* Perkins, holotype: g, valve (the teeth on the ventral appendage on this and other species are individually variable and may not be the same on both sides of the same individual; on this species the processes are strongly crossed in natural position); h, apex of aedeagus. i-k, *minimus* Perkins: i, valve; j, k, lateral and dorsal view of tenth sternite and aedeagus.

with *vagus*, but *vagus* has much wider cells, and the illustrations clearly demonstrate the differences. Once the distinction of cell width is learned, it is easy to sort out a mixed collection of the two species.

**Nesomicromus bellulus bellulus** Perkins (figs. 13, a; 15, b; 17, e-f; 21; 22, 23).

*Nesomicromus bellulus* Perkins, 1899:40, pl. 4, fig. 8. Zimmerman, 1948:152, fig. 47.

*Nesomicromus minor* Perkins, 1899:41. **New synonym.**

*Nesomicromus molokaiensis* Perkins, 1899:41. **New synonym.**

Endemic. Oahu (type locality of *minor*: Waianae Mts., 3,000 feet), Molokai (type locality of *molokaiensis*: "above 4,000 ft."), Maui (type locality of *bellulus*: Haleakala, 5,000 feet).

I have merged *molokaiensis* with *bellulus* because I have been unable to find any characters on the unique female holotype by which to distinguish it. It is an individual color form of a variable species. Perkins was correct when he wrote in

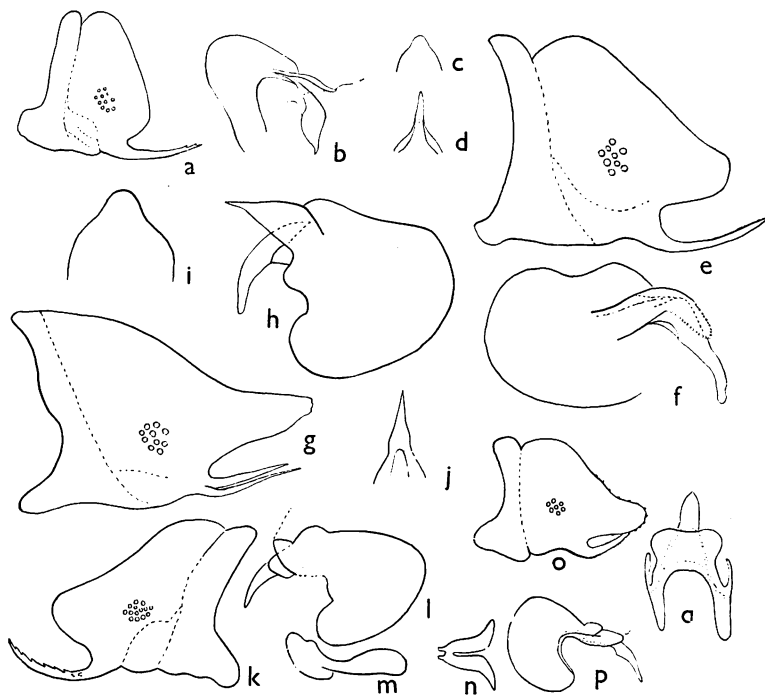


Figure 19—*Nesomicromus*, male genitalia. a-d, *paradoxus* Perkins: a, valve; b, tenth sternite and aedeagus; c, dorsal view of apical dorsal part of tenth sternite; d, dorsal view of apical part of aedeagus. e-f, *rubrinervis* Perkins, holotype: e, valve; f, tenth sternite and aedeagus. g-j, *subochraceus* Perkins: g, valve; h, tenth sternite and aedeagus; i, dorsal view of apical dorsal part of tenth sternite; j, dorsal view of apical part of aedeagus. k-n, *vagus* Perkins, holotype: k, valve (teeth on ventral process quite variable); l, tenth sternite and aedeagus; m, parameres; n, dorsal view of hypandrium. o-q, *angustipennis* Perkins: o, valve; p, q, lateral and dorsal views of tenth sternite and aedeagus. The parts in each group to scale, but the groups not all to the same scale.



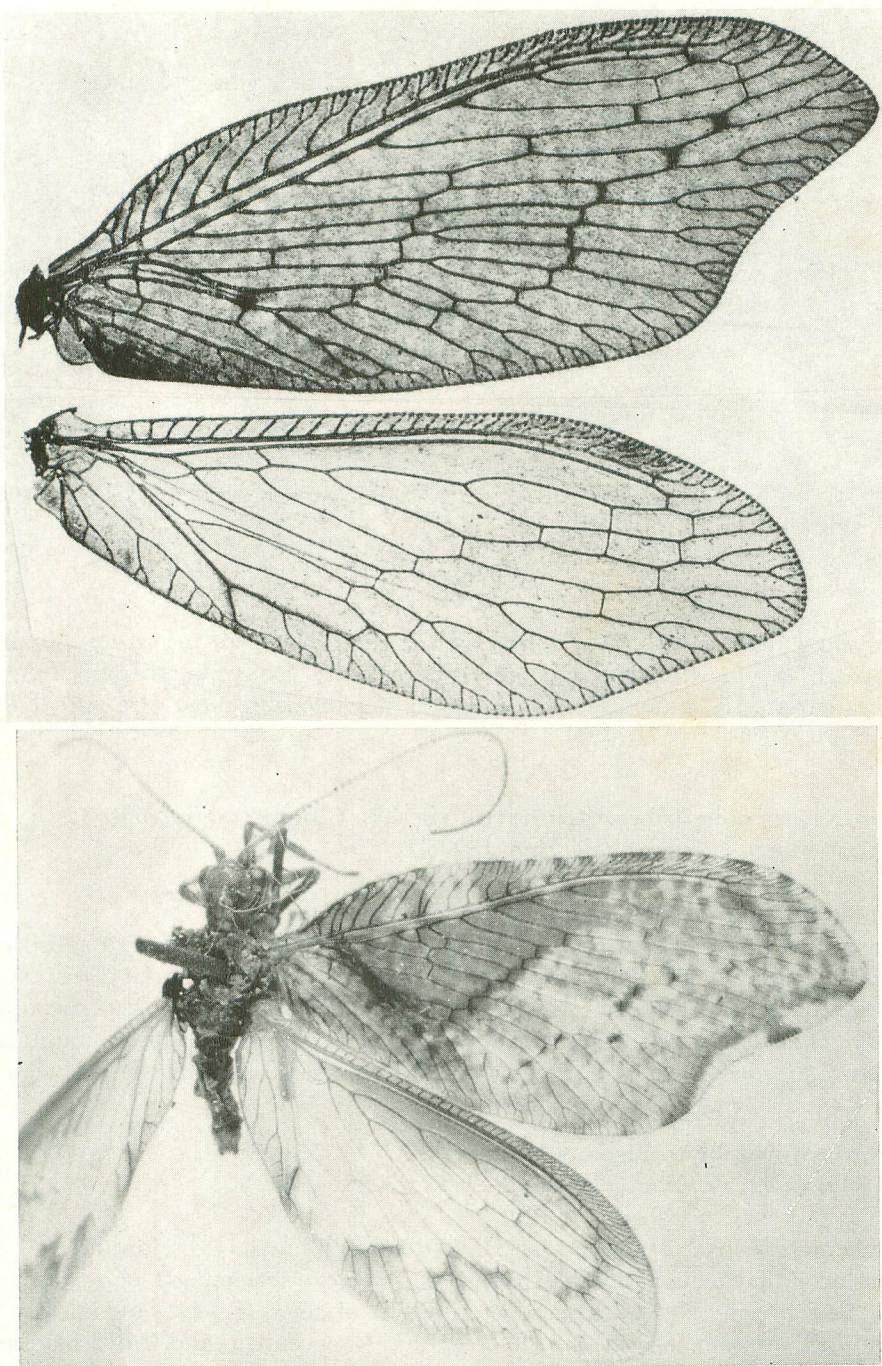


Figure 20—*Nesomicromus*. Top: wings of *angustipennis* Perkins, holotype; Waimea, Kauai, 4,000 feet; length of fore wing, 6.5 mm. Bottom: *angularis* Perkins, holotype; Molokai mountains, nearly 5,000 feet; length of fore wing, 9 mm.

The delicate mottling, or mackerel effect, of the membrane coloring on many of the wings of *Nesomicromus* unfortunately has not reproduced. Also, some of the veins in the hind wings show dark all along whereas, on some of the species, there are pale areas on some of the veins. It would have been better to have two photographs of each object—one taken with mostly transmitted light, the other, with mostly reflected light.

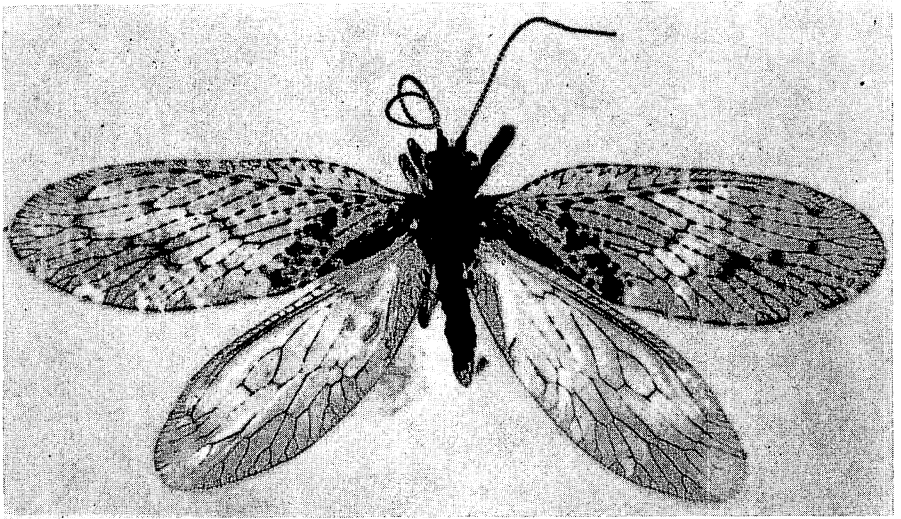


Figure 21—*Nesomicromus bellulus* Perkins, holotype; Haleakala, Maui, 5,000 feet; expanse, 17 mm.

his original description that "It is possible that this form may prove to be a variety of the preceding species." (That is, *bellulus*.) I have likewise been unable to differentiate the unique female holotype of *minor* and must also reduce it to synonymy.

***Nesomicromus bellulus infumatus* (Perkins), new status** (figs. 15, e; 23).  
*Nesomicromus infumatus* Perkins, 1899:41.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

I consider this to be a form of *bellulus*, and it is here reduced to subspecific status. Only the female holotype is known, and when more material is discovered it may be demonstrated that it is only a color form of *bellulus*. There are differences in the spermatheca, however, and these differences lead me to maintain it here as a subspecies; the lack of comparative material obscures the problem.

***Nesomicromus brunnescens* Perkins** (figs. 11; 17, a-d; 24).  
*Nesomicromus brunnescens* Perkins, 1899:43, pl. 4, fig. 9.

Endemic. Molokai (type locality: 3,000 feet), Maui, Lanai, Hawaii.

This is one of the more distinctive species. In all the specimens I have examined, M in the fore wing is twice forked before the gradate cross-veins, and usually the second fork arises before the second cross-vein between  $Cu_1$  and  $Cu_2$ . I have seen a similar double forking elsewhere only in *longispinosus* (two examples), in the unique type of *ombrias*, and in *bellulus* (several examples), in which the forking is variable and there may be one fork in one wing and two forks in the other



wing. It is probable, however, that the character may appear as an abnormality in specimens of some other species (see the comments under *longispinosus*). The Hawaii record is new and is based on a specimen taken at "29 miles, Olaa," September, 1953, by A. Suehiro.

**Nesomicromus distinctus** Perkins (figs. 17, g-k; 24).

*Nesomicromus distinctus* Perkins, 1899:44.

Endemic. Molokai (type locality: "taken in the mountains").

This species was described from an unique female, and I have seen only one other example, which was taken by D. E. Hardy in Maunawainui Valley, Molokai, in July, 1952. It is a male, and the genitalia are distinctive, as the illustrations show. The shape of the lateral valve is quite unlike that of any other species.

**Nesomicromus drepanoides** Perkins (figs. 12; 13, d; 15, a; 17, l-m; 25).

*Nesomicromus drepanoides* Perkins, 1899:39, pl. 4, fig. 6.

Endemic. Kauai (type locality: 4,000 feet).

There is much variation in the color of this species. Some examples are rather pale brown and conspicuously maculate, and others are very dark with little evidence of maculation. Also, there is much variation in size. The sinuation of the posterior margin of the fore wing is hardly evident in some examples (which might be confused with *vagus*), although it is normally well defined, and the contour of the posterior or "dorsal" margin of the wing serves as a convenient character to separate it and *vagus*.

**Nesomicromus falcatus** Zimmerman, **new species** (figs. 12; 17, p-s; 26).

Head and thorax marked variably with pale brown and dark brown; legs pale brown, the usual dark bands not very strong. Fore wing membrane brown, mottled; pale along distal side of 1A and in the apical branches of 1A; wing margin alternating pale and dark, the concave apical margin mostly white, but broken by extension of the dark membrane color; veins maculate. Hind wing and veins paler basad, darker distad. Pterostigmata not pink and without any pinkish tinge, not differentiated in color from adjacent areas.

Fore wing shaped as illustrated, proportionately broad for the genus, widest transverse chord one-half as long as greatest length of wing, strongly falcate, posterior margin conspicuously bisinuate; radius with five or six sectors (six sectors apparently usual, but number may vary in same individual), cells between the sectors broad, all much broader than widest space between subcosta and radius; distance along first radial sector between inner and outer gradate cross-veins distinctly longer than distance at same place between outer gradate cross-veins and wing margin; M forks before second cross-vein between  $Cu_1$  and  $Cu_2$ ;

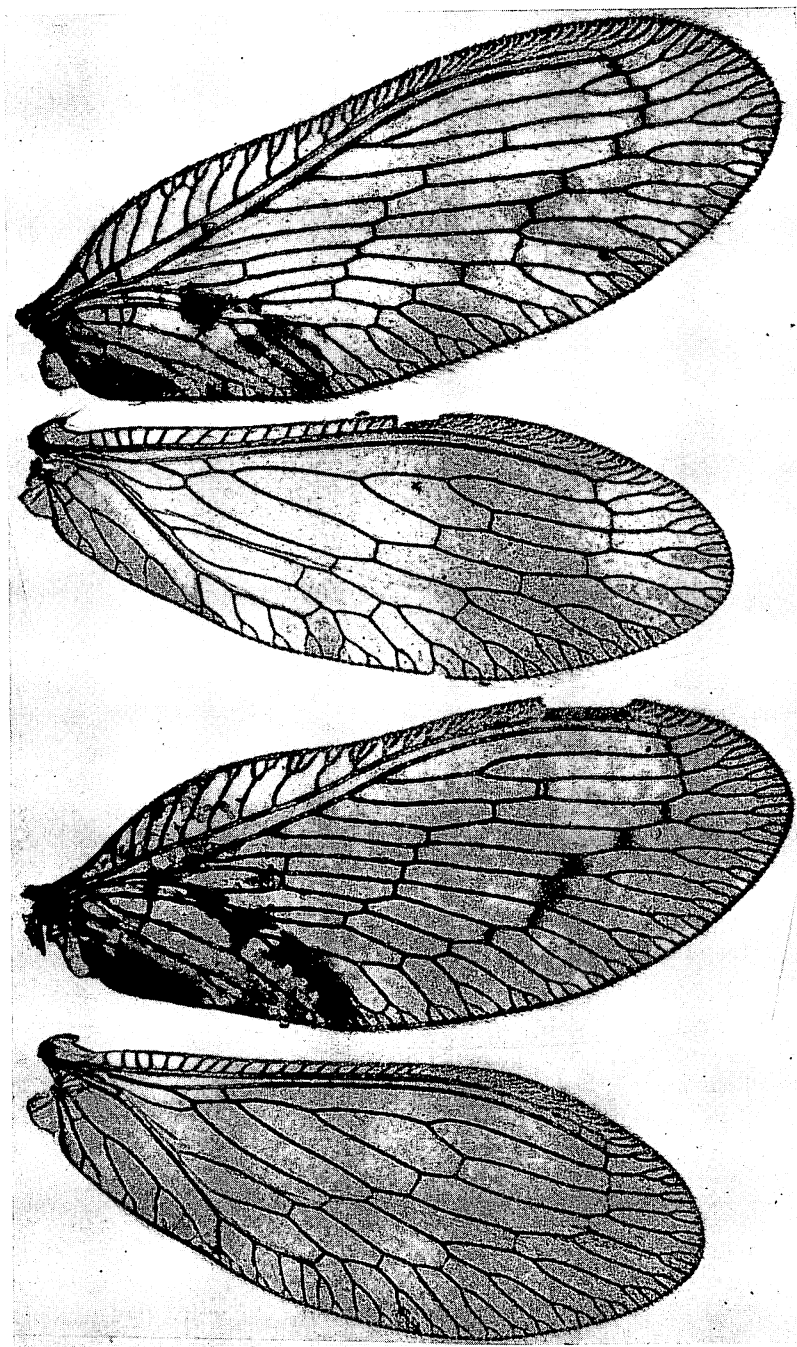


Figure 22—Wings of *Nesomicromus bellulus* Perkins. The top figure is of the male holotype; Haleakala, Maui, 5,000 feet; fore wing length, 8 mm. The bottom figure is of the female holotype of *molokaiensis* Perkins; Molokai mountains, 4,000 feet; length of fore wing, 8 mm.; here reduced to synonymy.



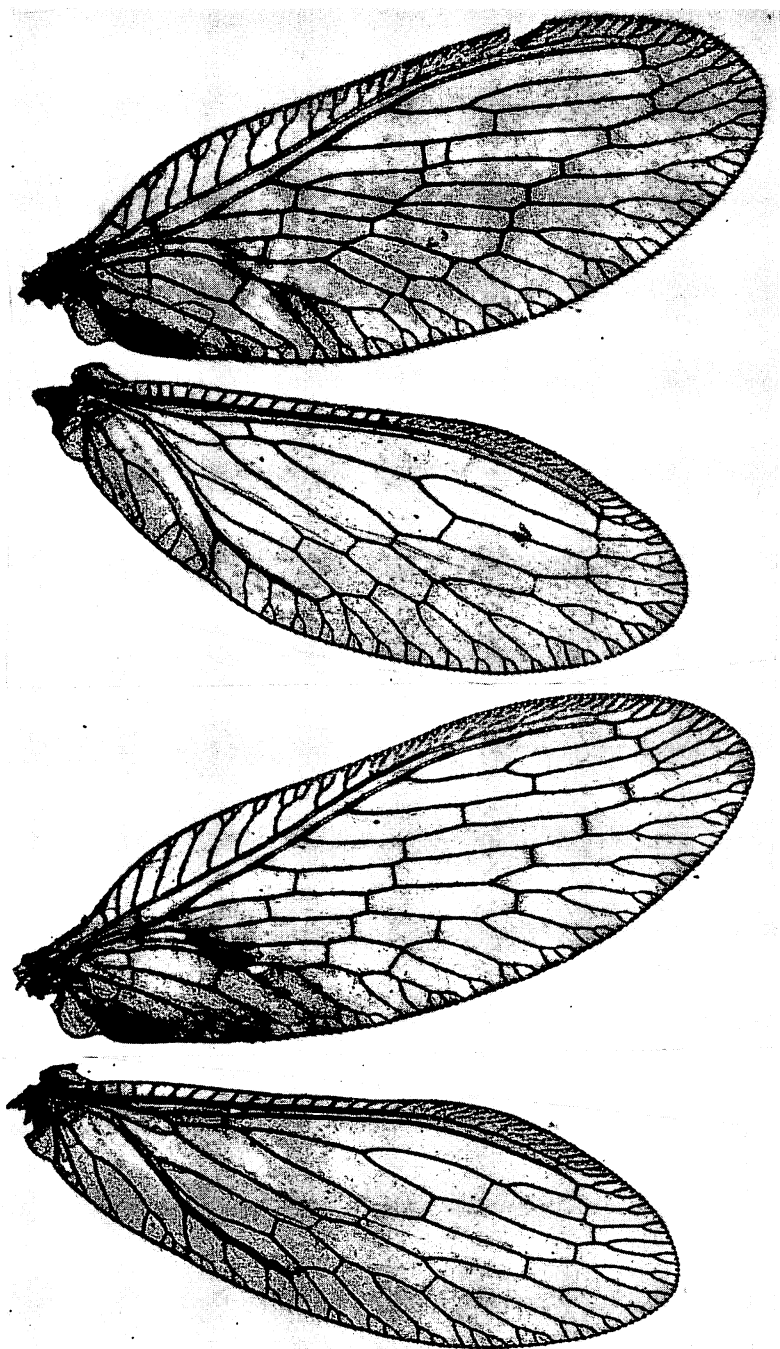


Figure 23—Wings of *Nesomicromus*. The top figure is of the holotype of *minor* Perkins; Waianae Mountains, Oahu, 3,000 feet; fore wing length, 7 mm.; here reduced to a synonym of *bellulus* (compare previous figure). Below are the wings of the holotype of *bellulus infumatus* (Perkins), holotype; Haleakala, Maui, 5,000 feet; fore wing length, 7.5 mm.

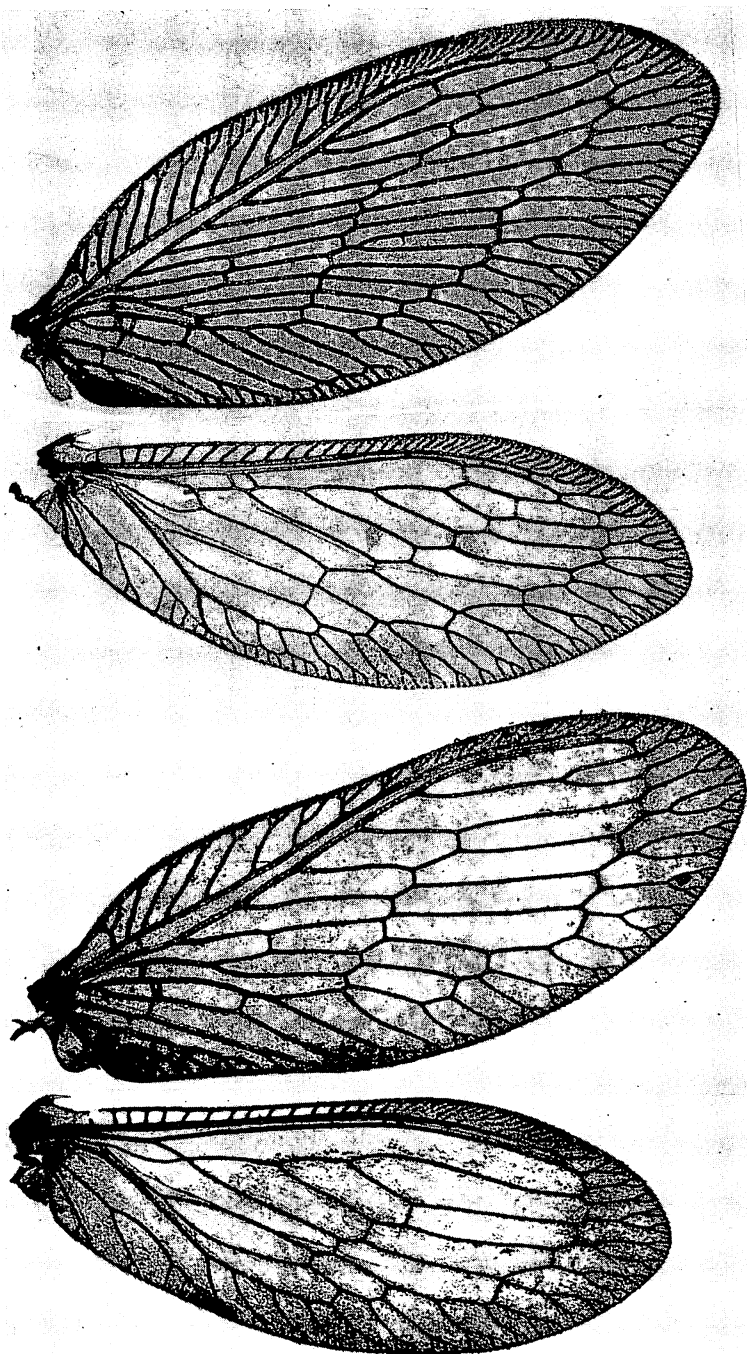


Figure 24—Wings of *Nesomicromus*. Top: *brunnescens* Perkins, holotype; Molokai mountains, 3,000 feet; fore wing length, 7 mm. Bottom: *distinctus* Perkins, holotype; Molokai mountains; fore wing length, 6.5 mm.

setae on veins in middle of wing about three or four times as long as breadths of veins. Length of a fore wing: 6 mm.; extreme breadth: 3 mm.

Hind wing shaped as illustrated, the posterior apical margin very nearly straight instead of concave as in the more falcate fore wing; no cross-veins between radius and sector beyond the "false origin" of radius at origin of first branch of sector in seven wings examined; four branches to sector in five hind wings examined, three on left hind wing of one male and three on right wing of one female; 1A forks at about its basal third; setae on distal half of wing two or more times as long as vein diameters.

Male genitalia as illustrated.

Endemic. Oahu. Holotype male, collected by R. C. L. Perkins and labeled "Honolulu Mts. 1,000 ft. Dec." (this probably refers to a locality on Mt. Tantalus); allotype female collected by O. H. Swezey at Waiahole, August, 1916; a female paratype collected by D. T. Fullaway at Waiahole, March 28, 1915; a male paratype collected by Swezey at Opaepa, March 30, 1913; and a paratype of undetermined sex (left hind wing and abdomen missing), labeled simply "Sp.? Oahu," from Perkins' collection. Holotype and allotype stored in Bishop Museum, Honolulu.

Because of the shape of the fore wings, this species appears rather similar to *drepanoides* Perkins from Kauai. The two species are easily separated by obvious characters. The new species has shorter and broader fore wings which are only twice as long as broad, but on *drepanoides* the fore wings are obviously narrower and are distinctly more than twice as long as broad. The cells between the radial sectors are obviously broader on *falcatus* than on *drepanoides*. The distance along the first radial sector between the inner and outer series of cross-veins in *falcatus* is longer at that level than the distance between the outer series of cross-veins and the wing margin, but it is shorter in *drepanoides*. On *drepanoides* the posterior apical margin of the hind wing is more strongly concave, and the pterostigma is pink. On all of the *drepanoides* I have examined, there is a cross-vein between R and Rs in the hind wing near the origin of the second branch of Rs, whereas there is none in that position in the specimens of *falcatus* examined. In *falcatus* 1A in the hind wings forks much farther basad than in *drepanoides*. The characters in the wings are best appreciated by examining the illustrations.

The male genitalia are strikingly different, as the illustrations clearly display. No other species of the genus yet examined has a dorsal process on the ventral process of the lateral valve, and the aedeagus complex is also definitive. The illustrations present these features better than words.

**Nesomicromus forcipatus** Perkins (figs. 18, a-b; 27).

*Nesomicromus forcipatus* Perkins, 1899:44, pl. 4, figs. 14, 14, a.

Endemic. Kauai (type locality: Makaweli, above 2,000 feet).

The male type of this interesting species, which is possibly a teneral example, is the only example known (my record 1940:504 citing a specimen from Oahu

appears to have been an error). Figure 14, a on plate 4 of *Fauna Hawaiiensis* is incorrect and misleading. The narrow processes of the lateral genital valves are ventral, and they project ventro-caudad as shown in my drawing. These setiform ventral processes of the genital valve are unusual and noteworthy reductions of the organ. The hairs on the wing veins are long, and the penultimate segment of the maxillary palpus is short.

**Nesomicromus fulvescens** Perkins (figs. 14, b; 27).

*Nesomicromus fulvescens* Perkins, 1899:39.

Endemic. Oahu (type locality: Waianae Mountains, 3,000 feet).

Only the female holotype is known. See the comments under *latipennis* below.

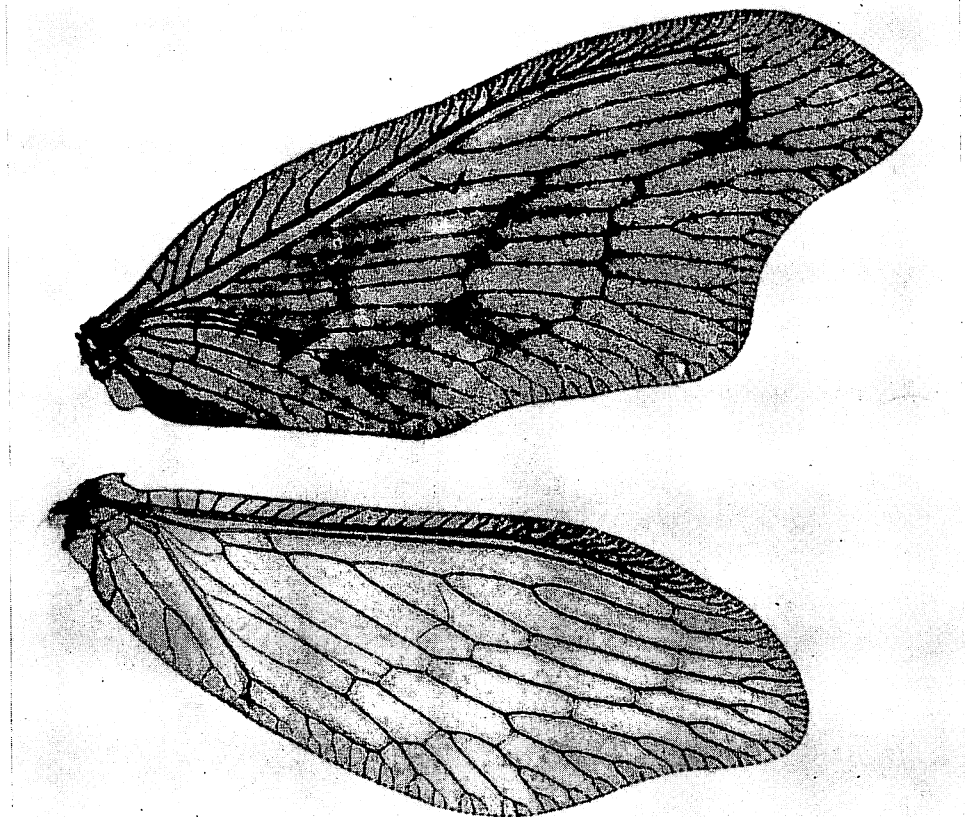


Figure 25—Wings of *Nesomicromus drepanoides* Perkins, holotype; Waimea, Kauai, 4,000 feet; fore wing length, 6.5 mm.

**Nesomicromus haleakalae** Perkins (figs. 15, c; 18, c-f; 28).

*Nesomicromus haleakalae* Perkins, 1899:42.

*Nesomicromus stenopteryx* Perkins, 1899:45. **New synonym.**

Endemic. Maui (type locality: Haleakala, 4,000 feet; type locality of *stenopteryx*, 5,000 feet).

The unique type of *stenopteryx* is only a diminutive male of *haleakalae* and the name must fall.

The male holotype has six and seven cross-veins between R and Rs in the hind

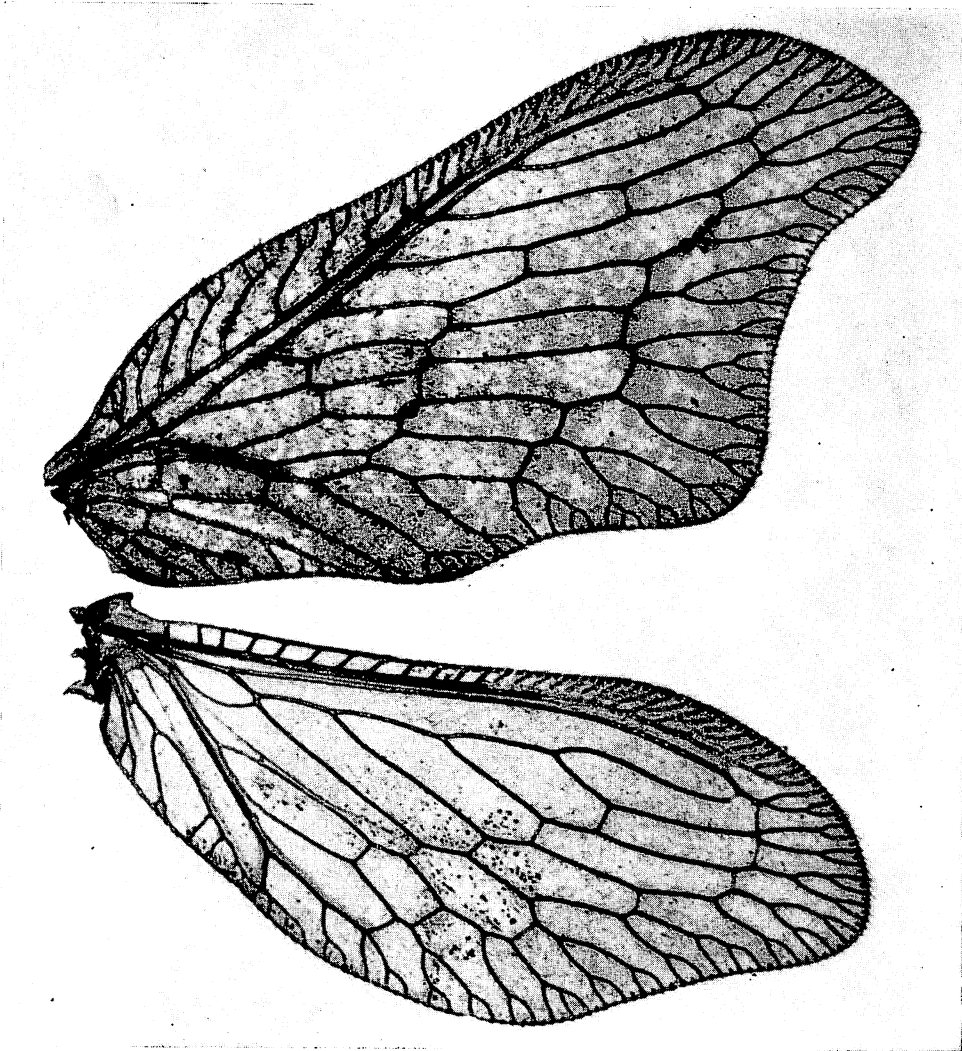


Figure 26—Wings of the holotype of *Nesomicromus falcatus* Zimmerman; Honolulu mountains, over 1,000 feet; fore wing length, 5.5 mm.

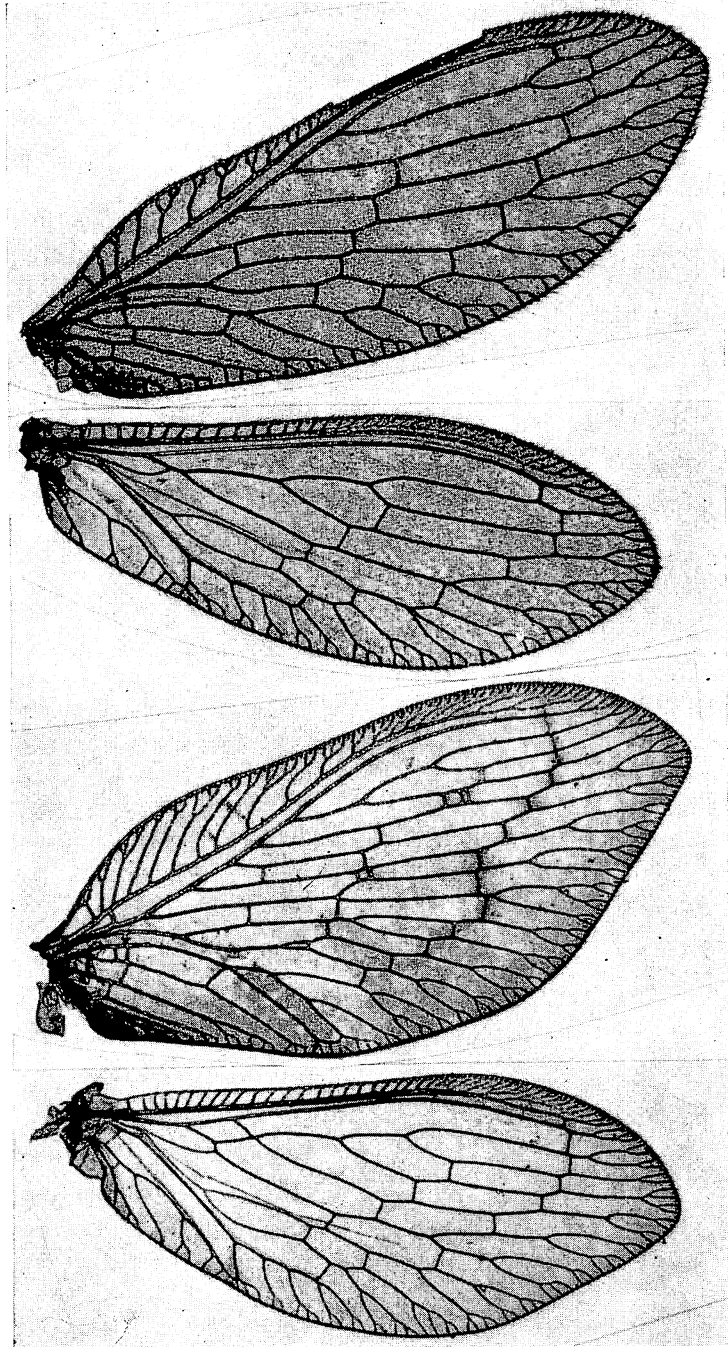


Figure 27—Wings of *Nesomicromus*. Top: *forcipatus* Perkins, holotype; Waimea, Kauai, 4,000 feet; fore wing length, 5.5 mm. Bottom: *fulvescens* Perkins, holotype; Waianae Mountains, Oahu, 3,000 feet; fore wing length, 7.5 mm.

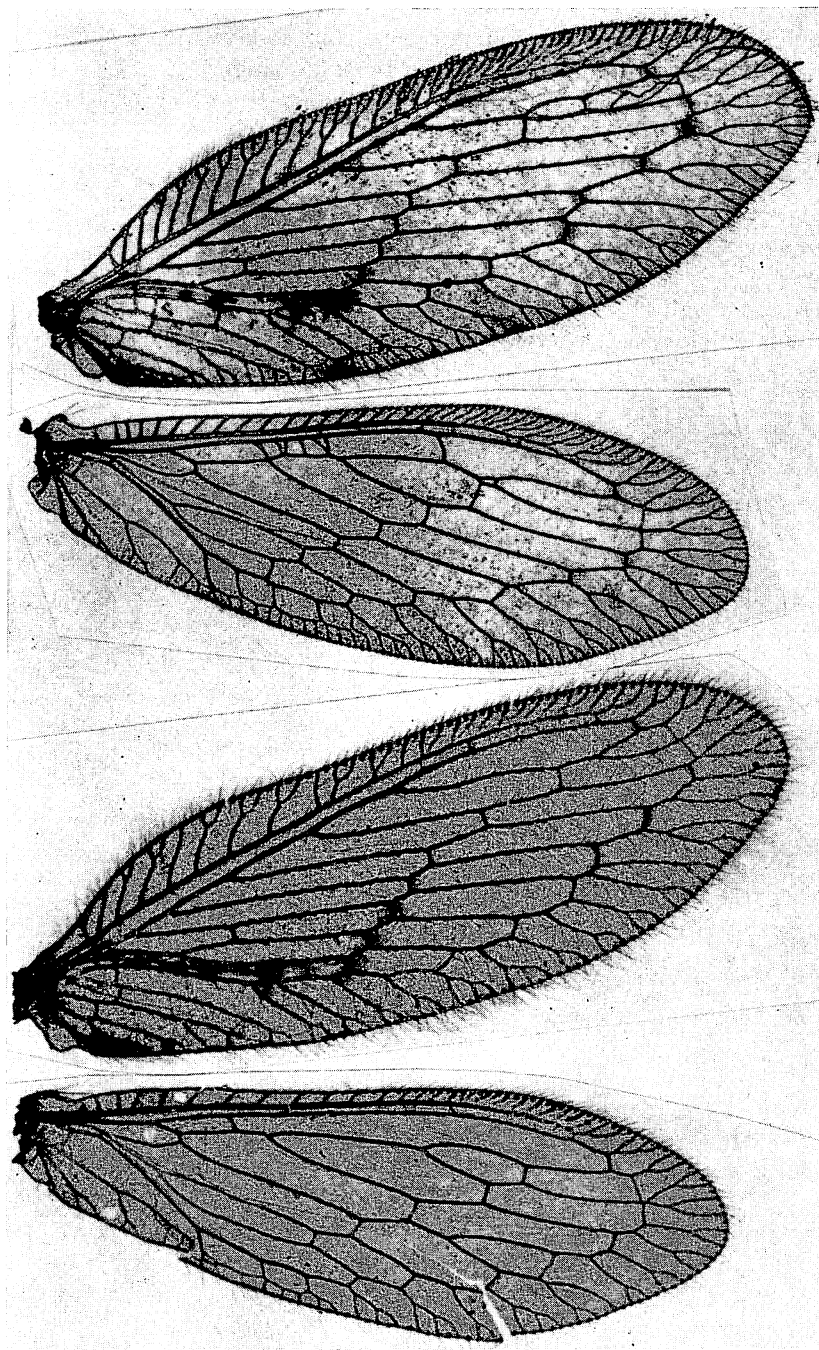


Figure 28—Wings of *Nesomicromus*. Top: *haleakalae* Perkins, holotype; Haleakala, Maui, 4,000 feet; fore wing length, 7.6 mm. Bottom: the holotype of *stenopteryx* Perkins; Haleakala, Maui, 5,000 feet; fore wing length, 5.5 mm.; here considered a synonym of *haleakalae*.



wings but this character is variable, and there may be only one or two. The species has been known only from the type, but I have seen a male taken by Swezey on *Raillardia* at the summit of Haleakala, August 17, 1929, and a specimen, without an abdomen, collected by Timberlake from *Dryopteris* fern at Puu Nianiau, July 19, 1919.

**Nesomicromus latipennis** Perkins (figs. 14, c; 29).

*Nesomicromus latipennis* Perkins, 1899:38, pl. 4, fig. 4.

Endemic. Hawaii (type locality: Kona, 3,500 feet).

The female holotype is the only example known. In general facies, because of its broad wings, it resembles *fulvescens* from Oahu, and it has the appearance of

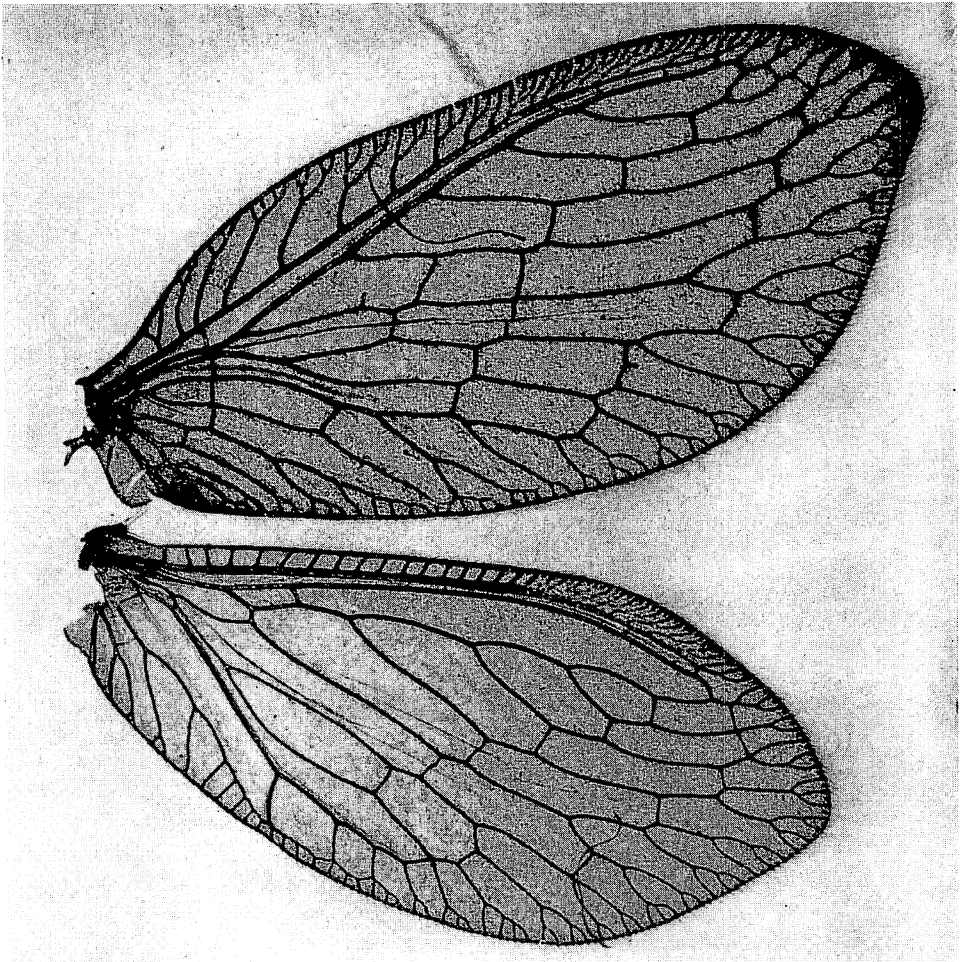


Figure 29—Wings of the holotype of *Nesomicromus latipennis* Perkins; Kona, Hawaii, 3,500 feet; fore wing length, 7.25 mm.



being an unusually broad-winged form of *vagus*. The cells are very broad, and in this feature it bears the same kind of relationship to *fulvescens* as *vagus* does to *angustipennis*.

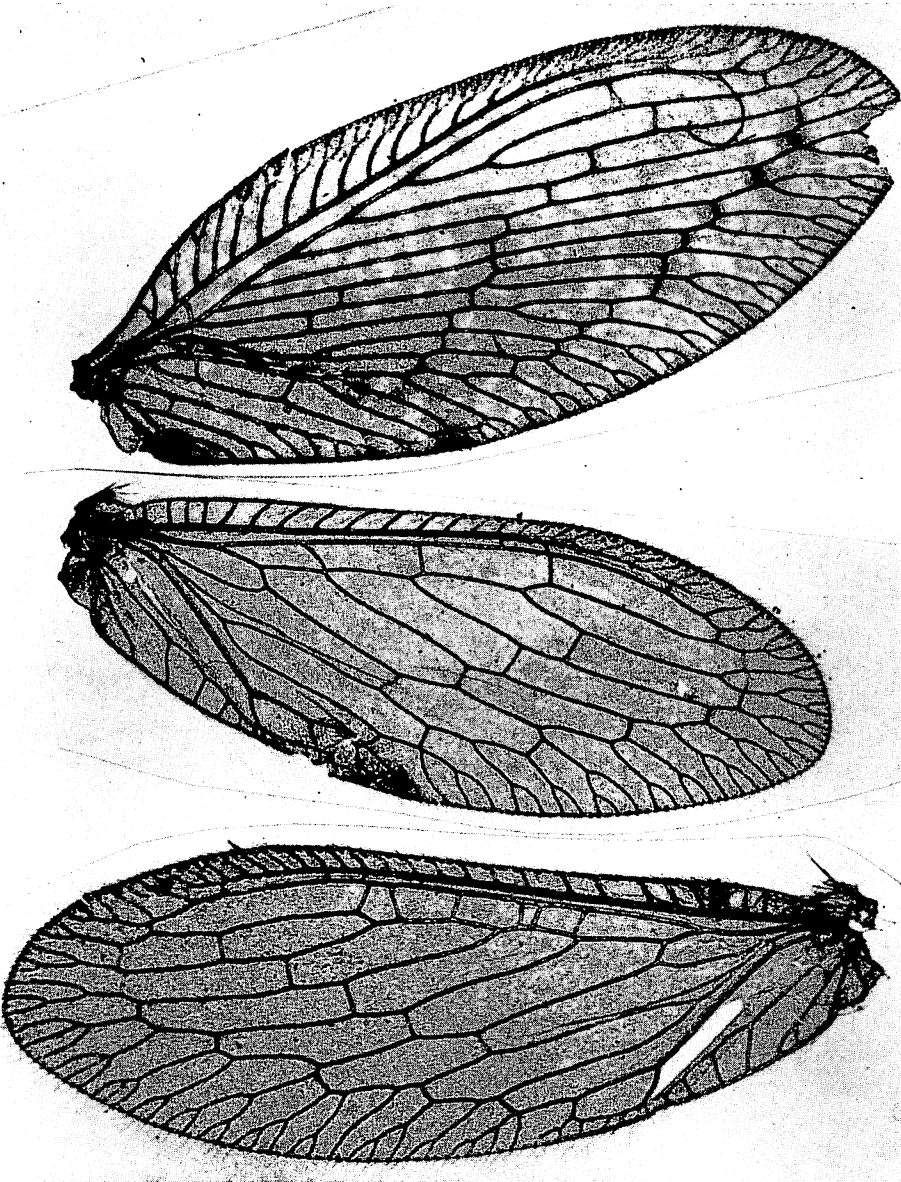


Figure 30—Wings of *Nesomicromus longispinosus* Perkins. The upper figures are from an example from the National Park, Hawaii; fore wing length, 6.6 mm. The lower figure is the left hind wing of the type from Kau, Hawaii, 4,000 feet; length, 5.2 mm. Note the variable number of cross-veins between R and Rs in the hind wings.

**Nesomicromus longispinosus** Perkins (figs. 18, g-h; 30).

*Nesomicromus longispinosus* Perkins, 1899:42, pl. 4, fig. 15.

Endemic. Hawaii (type locality: Kilauea, 4,000 feet).

The left fore wing of the male holotype in the British Museum was evidently lost long ago. The lateral valves of the male genitalia, with their very long ventral processes, are diagnostic. Perkins noted the fact that in the specimens he had seen there was an unusually large number of cross-veins between R and Rs in the hind wing. The character is, however, variable, and other species also have a multiplicity of these cross-veins. In the type there are five in one wing and six in the other. Another example has three in one wing and four in the other. The right fore wing of the type has four cross-veins before the normal subapical cross-veins between R and the distal sector beyond where it branches off from R. Another example has only one such extra cross-vein. For species which appear outwardly so similar as this species and *brunnescens*, it is unusual to find their genitalia so different. I have failed to find reliable differences in the venation of the few specimens before me. The fore wings of the two species are so similar that I once considered that the abdomen of the type might really not belong to it, but I have since examined additional material and confirm the differences in the male genitalia in the two species.

**Nesomicromus minimus** Perkins (figs. 18, i-k; 31).

*Nesomicromus minimus* Perkins, 1899:45, pl. 4, fig. 11.

Endemic. Molokai, Hawaii (type locality: Kau, 4,000 feet).

I have studied seven specimens in the type series at the British Museum, and the following observations on the variation of these examples may be recorded:

The female holotype, Kau, 4,000 feet, August, 1895: R has four sectors; M forks slightly basad of the origin of first Rs in both fore wings (see figure 31).

A female from Kau, August, 1896: R has four sectors; M forks nearly opposite the origin of first Rs in right wing, but it forks basad of that point in the left fore wing.

A male from Kona, 4,000 feet, August, 1892: R has four sectors; M forks opposite the origin of first Rs in left wing but slightly basad in the right fore wing.

A male and a female from the Molokai mountains, 3,000 feet, June, 1896: R has four sectors; M forks slightly basad of the origin of the first Rs in both fore wings.

A female with the same field data: R has four sectors in the left wing, but there are five in the right wing; M forks opposite the origin of the first Rs in the right fore wing, but it forks basad in the left wing.

A female with the same field data: R has four sectors in each wing; M forks nearly opposite the origin of the first Rs in left wing, but in the right wing it forks somewhat distad, and this example is unusual because the second cross-vein between Cu<sub>1</sub> and Cu<sub>2</sub> is missing in both wings.

All these examples have the fore-wing membrane mottled with mostly separate brown spots giving a mackerel effect. In all of them the setae on the veins are

only about twice as long as the breadth of a vein and much less than one-half as long as the breadths of the cells. In all, the first Rs begins at a point distad of the anterior end of the second cross-vein between  $Cu_1$  and  $Cu_2$ . In all, M forks opposite to the second cross-vein between  $Cu_1$  and  $Cu_2$ . The wing veins of the type have a pinkish tint, but it is not as strong as it is in *rubrinervis*. None of these examples has a pink pterostigma in the hind wings as does *rubrinervis*.

Additional comparative notes are given under *rubrinervis* below.

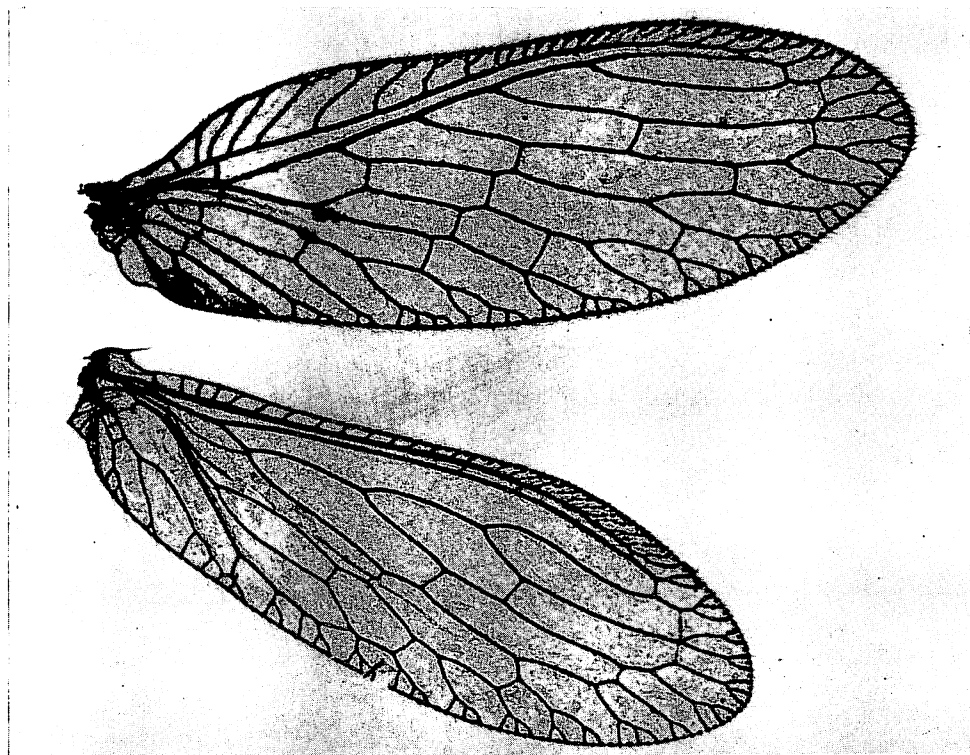


Figure 31—Wings of the holotype of *Nesomicromus minimus* Perkins. Kau, Hawaii; fore wing length, 5.25 mm.; does not show the well-marked mackerel color pattern in fore wing membrane.

***Nesomicromus navigatorum* (Brauer), new combination** (figs. 11; 14, a; 16; 32).

*Micromus navigatorum* Brauer, 1867:508.

*Micromus vinaceus* Gerstaecker, 1885:111. Williams, 1927:246–249; and 1931:129–130, biology.

*Archaeomicromus navigatorum* (Brauer) Esben-Petersen, 1928:93; 1937:51.

*Eumicromus navigatorum* (Brauer) Kimmins, 1936:87. Zimmerman, 1940:502.

The Australian brown lacewing.

Niihau, Kauai, Oahu, Molokai, Maui, Hawaii.

Introduced. This species, which was originally described from Fiji and Samoa,

was purposely introduced from Queensland, Australia, by F. X. Williams in 1919. It is a widespread species from eastern Australia to New Guinea, New Caledonia, New Hebrides, Fiji, Samoa, and west to Malaya, Ceylon, India and possibly Africa, and it probably occurs in many other unrecorded localities.

Hosts: *Aphis maidis* Fitch, *Aphis sacchari* Zehntner, *Cerataphis lataniae* (Boisduval).

This common species resembles closely some of our endemic *Nesomicromus* which have the apices of their fore wings rounded; but it may be distinguished from most of those species because of its pale brown color, which, once learned, will enable one to sort the species out of mixed collections of Hawaiian Hemerobiidae.

In life, the eyes are beautiful, gleaming, dark metallic green. The legs are straw-colored. The dusky thorax and abdomen may be tinged with pink. In both pairs of wings the gradate cross-veins and the veins between the origins of the cross-veins are dark, and together these dark veins form a dark zigzag line from M to R (see figure 32). The iridescence of the wing membrane is intense in certain lights. The fore wings have five or, usually, six radial sectors. The hairs on the wing veins are dense and nearly as long as the breadths of the cells.

In 1919, Dr. F. X. Williams observed this species feeding upon aphids on sugarcane at Halifax, North Queensland, and in August of that year he brought

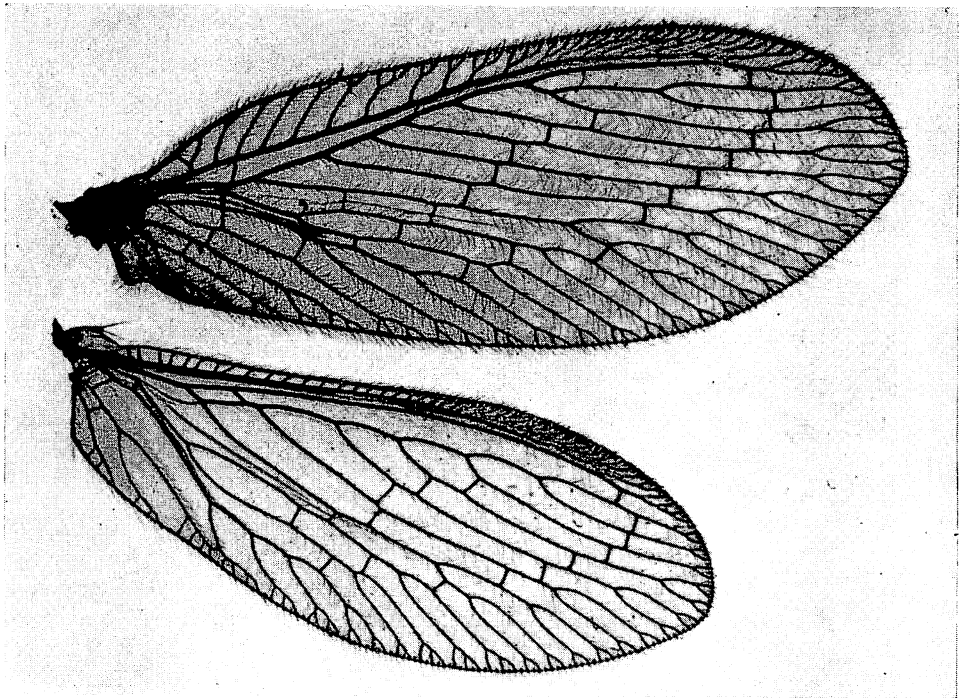


Figure 32—Wings of a female *Nesomicromus navigatorum* (Brauer) from Honolulu; fore wing length, 7.5 mm.

back 14 living specimens to the Experiment Station, Hawaiian Sugar Planters' Association. From these specimens, over 5,000 adults and a large number of eggs were reared in the Honolulu laboratory and released on the sugar plantations of Kauai, Oahu, Maui and Hawaii, where the insects quickly established themselves. The first field release was made at Waipio, Oahu, in September, 1919, and the rearing closed with the release of the seventeenth laboratory-reared generation on the Experiment Station grounds in Honolulu in August, 1920. The following account is taken from Williams (1927:246-249):

The females, if given adequate quantities of food, may each lay hundreds of eggs. The eggs, which measure about 0.3 mm. wide and 0.75 mm. long are laid in groups. One female commenced laying at the age of three days and had laid 558 eggs when she died at age 30 days. Another female laid 619 eggs during 18 of her 21 day life. The eggs hatch in about three days. The first stage larvae are about two mm. long, are apt to feed upon the eggs of their brothers and sisters, but they usually run about searching for aphids and possibly other small insects and acari. The first instar lasts only about a day. When ready to molt the larva exudes some adhesive material from the anus and glues its tail to the substratum, becomes quiescent for a short time and then splits its old skin and crawls out as a second instar larva about four mm. long. In about 24 hours of voracious feeding it molts to a third stage larva about six mm. long. If adequate food is available it may spin its net-like cocoon within 48 hours of its second molt. Within a week the pupa becomes active and bites its way out of the cocoon, rests, and its skin splits down the back and the adult emerges. Under optimum conditions the entire life cycle may be completed within two weeks. Thus, this species may build up its populations very quickly.

In its four days or so of active life as a larva, *Micromus* feeds voraciously. Unlike the larvae of certain green lacewings it does not adorn its body with a protective covering of the skins of its dry-sucked victims, but it runs about naked and comparatively defenseless, and we must attribute its success in its struggle for existence, in great measure, to the large number of eggs laid, over a relatively long period by a single female. As observed in captivity one larva will readily devour another of its kind and occasionally we see a specimen whose curtailed posterior extremity would indicate bare escape from the jaws of one of its hungry fellows. A larva on the move sways the head from side to side in jerky fashion and feels its way or, its food, by means of the downward-pointing palpi; when it encounters another *Micromus* larva, it will often jab or peck at it with open jaws, the offended relative retaliating with blows from its tail; sometimes two will unwillingly share an aphid but one will eventually pull the morsel away from the other. When an aphid is encountered it may or may not be seized immediately, *Micromus* will palp it perhaps, or make cautious digs at it with open mandibles sometimes thus piercing it; the homopteron thus apprised of its peril becomes very agitated; it may beat a retreat or sway its uplifted abdomen and exude a darkish liquid from the tubular processes [cornicles] near the end of the body. After such and additional preliminaries, *Micromus* deeply stabs its victim, commences sucking immediately and bracing itself pulls its prey off the leaf and raising it aloft soon converts the unfortunate bug into a collapsed sack. While thus feeding, the antennae and palps are held clear of the aphid.

The adults, too, are ravenous aphid-eaters, and they consume great quantities of these plant pests. Williams, observing a newly emerged pair of adults, found that the female ate 15 aphids in 10 minutes while her mate ate 13 in 7.5 minutes.

***Nesomicromus ombrias* Perkins (fig. 33).**

*Nesomicromus ombrias* Perkins, 1910:692.

Endemic. Oahu (type locality: "mountains near Honolulu," 1,500 feet; presumably the Mt. Tantalus area).

The unique male holotype is in Bishop Museum.

**Nesomicromus paradoxus** Perkins (figs. 13, e; 19, a-d, 34; 35).

*Nesomicromus paradoxus* Perkins, 1899-39, pl. 4, fig. 7.

Endemic. Molokai, Hawaii (type locality: Kau, 4,000 feet, as the holotype is labeled; in the original description it is given as Kilauea).

This is one of the most remarkable of all Hawaiian Neuroptera. The unusual wing shape is diagnostic, and the lateral valves of the male genitalia are shorter than those of any of the other endemic species I have examined. Only four specimens are known, two from Hawaii and two from Molokai, but we may expect that the species will be found on Maui. The pterostigmata on the female holotype in the British Museum are pink, a feature which was not mentioned in the original description.

The variation displayed by the four known examples is unexpected and confusing. When I first saw the example recorded below from Puu Kolehale, Molokai, it appeared that a remarkable new species had been discovered, but after study I concluded that it must be a new subspecies. When the example from the Kohala Mountains was sent to me, it, too, appeared to represent a distinct subspecies. However, the addition of the second specimen from Molokai demonstrates that the species is extraordinarily variable and that each of these examples is just an individual variant which cannot qualify for a separate name. An examination of the illustrations will reveal the nature of some of the variation.

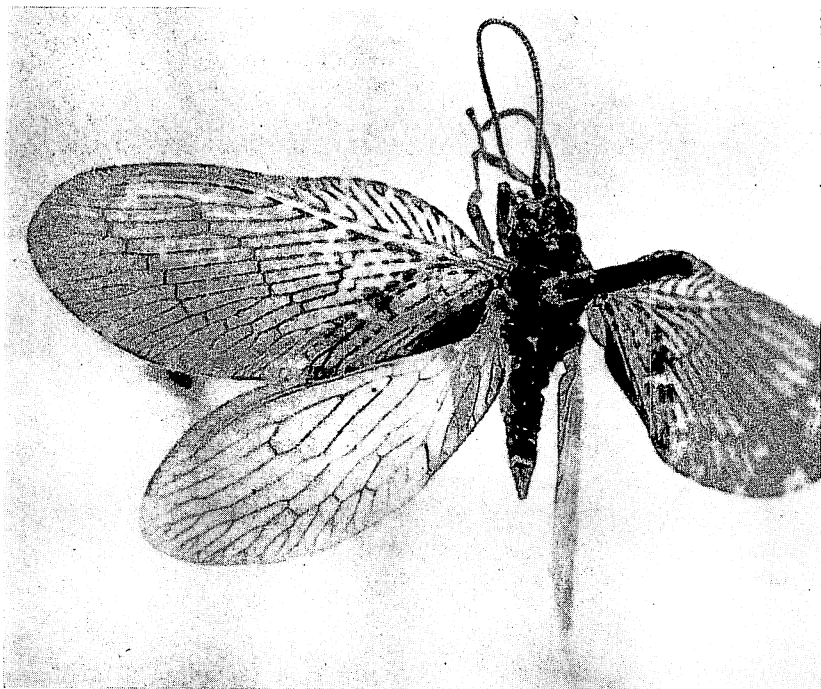


Figure 33—The holotype of *Nesomicromus ombrias* Perkins, male; Honolulu, 1,500 feet; fore wing length, 6.5 mm.

The specimen from Puu Kolekole, Molokai, collected by D. E. Hardy, July, 1952, is a remarkable color form. The fore wing on the right side has five radial sectors, with the fifth sector forked; the left wing has four sectors with the fourth one forked. The fore wings of the type have six sectors. The pterostigmata in both pairs of wings are pink-tinged. The fore-wing membrane is very dark brown or nearly black, mottled and blotched with white; the largest white macula is a sub-ovate spot between the second and third radial sectors (as in the left wing) or across the third sector (as in the right wing) between the gradate series of cross-veins. This white spot fits over a similar white spot on the second branch of the radial sector in the hind wing when the wings are closed. The veins are white in the white maculae. In the hind wings there are three branches to the radial sector instead of four as in the holotype. The excavations of the posterior margins of the hind wings are somewhat deeper than on the holotype.

The specimen from the Kohala Mountains, Hawaii, was taken by Dr. Swezey on *Broussaisia* on the Upper Hamakua Ditch Trail on October 3, 1919. This form is intermediate in coloring between the type and the Molokai specimen just described. There is no pink coloring in the wings as there is in the other two forms, but the absence of that color might possibly be due to fading, although it appears more probable that the specimen lacked pink coloring when it was captured. The differences in proportions and contours of the wings is more pronounced in this example. The wing membrane is brown, irregularly spotted with white; the wings are proportionately shorter and broader than in the holotype (breadth of fore wing divided into length equals 2.30; on the holotype it equals 2.47); the pterostigmata are not pink; in the right fore wing there are five radial sectors, and the fifth is forked, and in the left fore wing there are six sectors with the third and fourth arising from the same place; the left hind wing has three branches to the radial sector, but in the right hind wing the distal branch is a fork of the second branch instead of arising from the radial sector.

Such variation and small series of specimens are a trial to the systematist.

***Nesomicromus rubrinervis*** Perkins (figs. 19, e-f; 36).

*Nesomicromus rubrinervis* Perkins, 1899:43. Zimmerman, 1948:152, fig. 47.

*Nesomicromus rubrinervis* "var. a" Perkins, 1899:43.

Endemic. Hawaii (type locality: Puna, 2,000 feet). Perkins listed the type locality as Kilauea, 4,000 feet, in *Fauna Hawaiiensis*, but he appears to have been in error. The holotype is from Puna, 2,000 feet.

Only the male holotype of *rubrinervis* is in the British Museum, and no representatives of the supposed variety are now there. In his original description Perkins said that he had two females in addition to the male type, and he called these "var. a" and described them as "Dark brown in colour, wings dark, shorter and wider than in the type, pterostigmata and nervuration pink. Radius with 5 sectors." His type has four sectors in the fore wing. I am not sure that his females are the same species, but I have not examined them at this writing and cannot

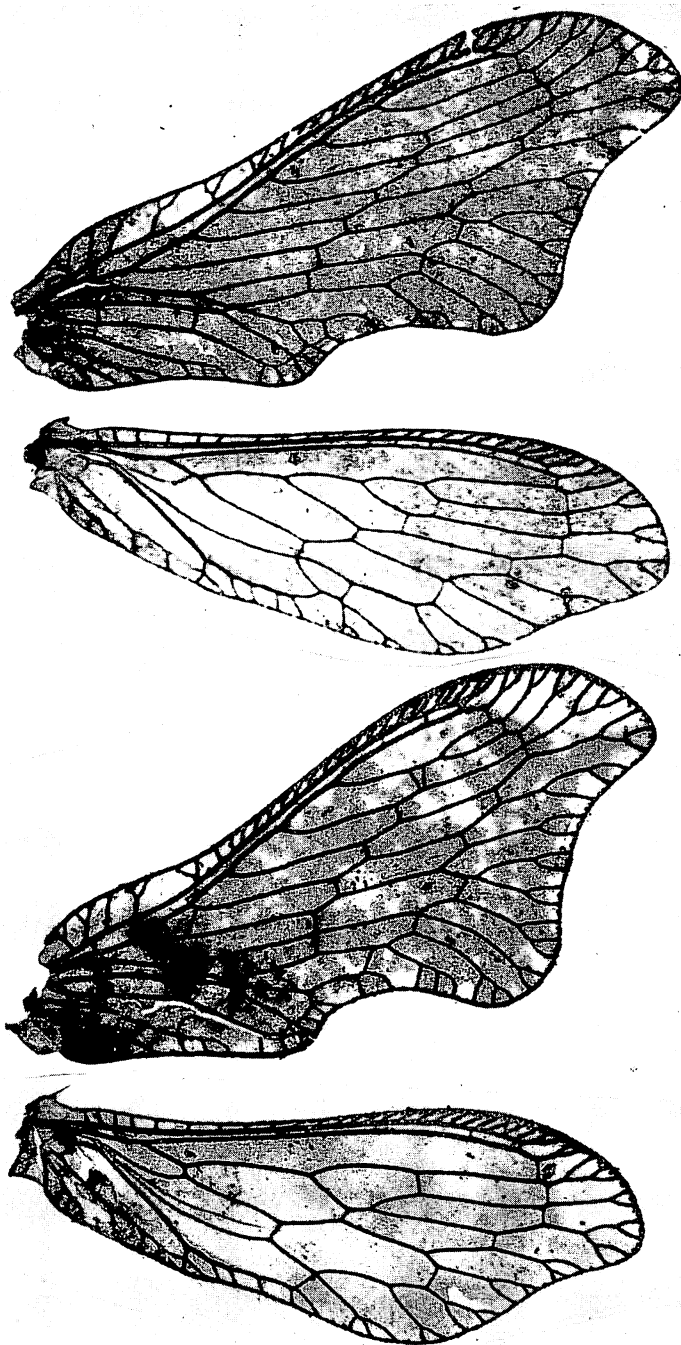


Figure 34—Wings of *Nesomicromus paradoxus* Perkins. Upper figure from the holotype; Kau, Hawaii; fore wing length, 5.25 mm. Lower figure from an example from the Upper Hamakua Ditch Trail, Kohala Mountains, Hawaii; fore wing length, 4.8 mm.



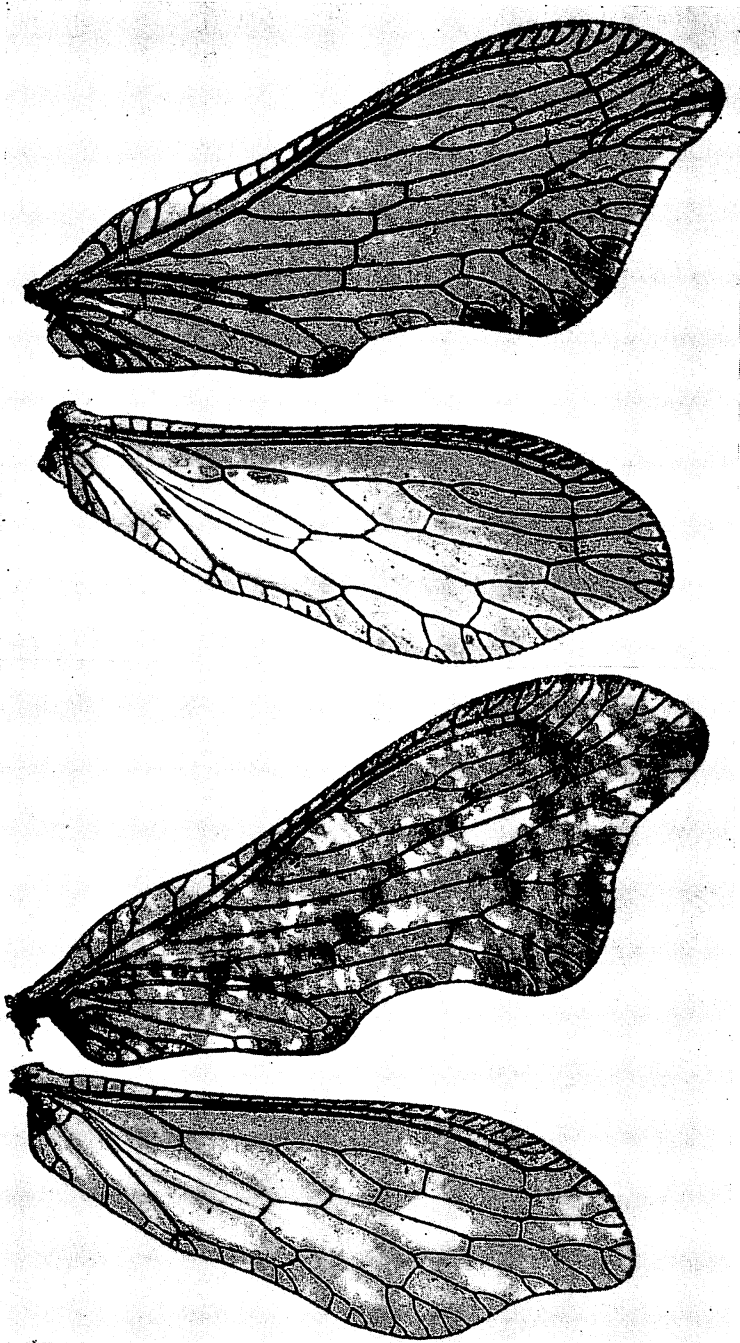


Figure 35—Wings of *Nesomicromus paradoxus* Perkins. Upper figure from an example from above Waikolu Valley, Molokai; fore wing length, 5 mm. Lower figure from a specimen from Puu Kolehale, Molokai; fore wing length, 5.5 mm.

render an opinion. His note that the wings are broader may draw attention to a feature which may indicate that another species is involved, and it may be *subochraceus*.

The holotype is much like *minimus*, but the first Rs begins basad of a line from the anterior end of the second cross-vein between  $Cu_1$  and  $Cu_2$ , and M thus forks considerably distad of the origin of the first Rs. The membrane of the fore wing is clouded overall with brownish, and the color is not broken up into distinct maculae, although there is a faint tendency to do so in some places. The veins in both pairs of wings are conspicuously pink, as is the pterostigmata of the hind wings. The setae on the fore-wing veins of the type are obviously longer than on the type of *minimus*, and some of them are about as long as half the breadths of the cells. In some places where the setae are artificially bent toward one another from the opposite sides of cells, their tips touch; this could never happen in any of the examples of *minimus* examined, but, of course, the addition of another sector, or forking of the outer sector, would make the cells narrower and the setae proportionately longer. In both fore wings the fourth radial sector forks and the anterior

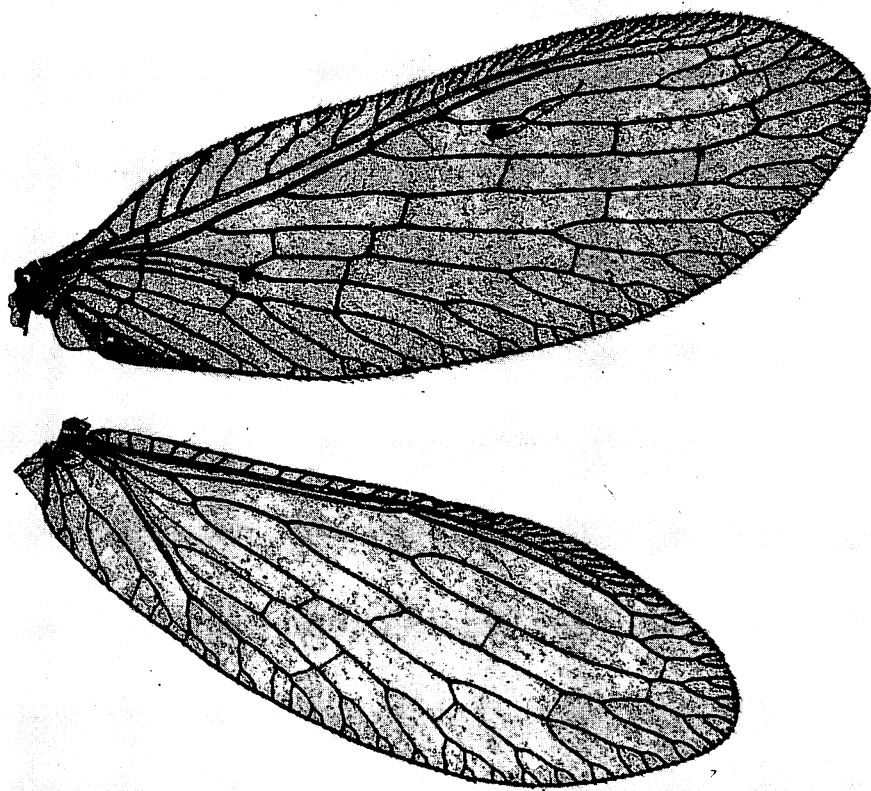


Figure 36—Wings of the type of *Nesomicromus rubrinervis* Perkins. Puna, Hawaii, 2,000 feet; fore wing length, 6.25 mm.

fork also forks. On a male and female *minimus* from Kau the fourth radial sector forks in both fore wings, but it does not fork on the other examples studied except on a male from Kona where it forks on the left wing only. The posterior margin of the wings is flatter before it enters the apex in the type of *rubrinervis* than in the type of *minimus*, as the illustrations demonstrate. The wings of the two types have somewhat different coloring and are of a different facies. The male genitalia are so similar that I am not sure that two species are involved. It may be that *rubrinervis* is a race of *minimus* or the type may be an abnormal individual. Only by the examination of adequate material can we solve the problem. Because of the longer setae, wing shape and different coloration, I leave the two forms separate as Perkins described them.

Since the above notes were written, some additional specimens of *rubrinervis* from Kilauea and Kau have been seen, and the setae on the fore-wing veins are not as long as those on the holotype, and the setae appear to vary somewhat in length.

**Nesomicromus subochraceus** Perkins (figs. 13, b; 19, g-j; 37).

*Nesomicromus subochraceus* Perkins, 1899:44, pl. 4, fig. 10.

Endemic. Oahu, Molokai (type locality: "Molokai Mts.," 2,000 feet), Maui, Hawaii.

I have seen some material misidentified as *rubrinervis*, and the two species may be confused. The genitalia are remarkably different, and *subochraceus* is a broader-winged species with a distinct venation as detailed in the key and as illustrated. The veins and pterostigmata may be as red as *rubrinervis*, but the red coloration is variable and may be absent. The fore-wing membrane is mottled. The posterior subapical margin of the wings is nearly straight before the apex and is distinct in curvature from the subapical costal margin. There may be four or five radial sectors in the fore wing. The split ventral process on the genital valve is unique.

**Nesomicromus vagus** Perkins (figs. 3; 4; 5; 12; 13, c; 14, d; 15, d; 19, k-n; 37).

*Nesomicromus vagus* Perkins, 1899:37, pl. 4, fig. 3. Zimmerman, 1948:152, fig. 47. Type of the genus.

Endemic. Kauai, Oahu, Molokai, Maui, Lanai, Hawaii (type locality: Kau).

Hosts: *Aphis gossypii* Glover, *Aphis sacchari* Zehntner, *Toxoptera aurantii* (Boyer de Fonscolombe).

This is a common and widespread species. Its abundance and distribution are most unusual, and it almost has the habits of an immigrant species. It is not uncommonly found in the lowlands in some regions, and it is even found on sugarcane. The contrast between it and most of its congeners is most striking. Why should just one of 19 endemic species of this genus be an abundant, nearly ubiquitous species while the others are mostly uncommon or rare? Few entomologists have ever seen any live species of Hawaiian *Nesomicromus* other than *vagus*.

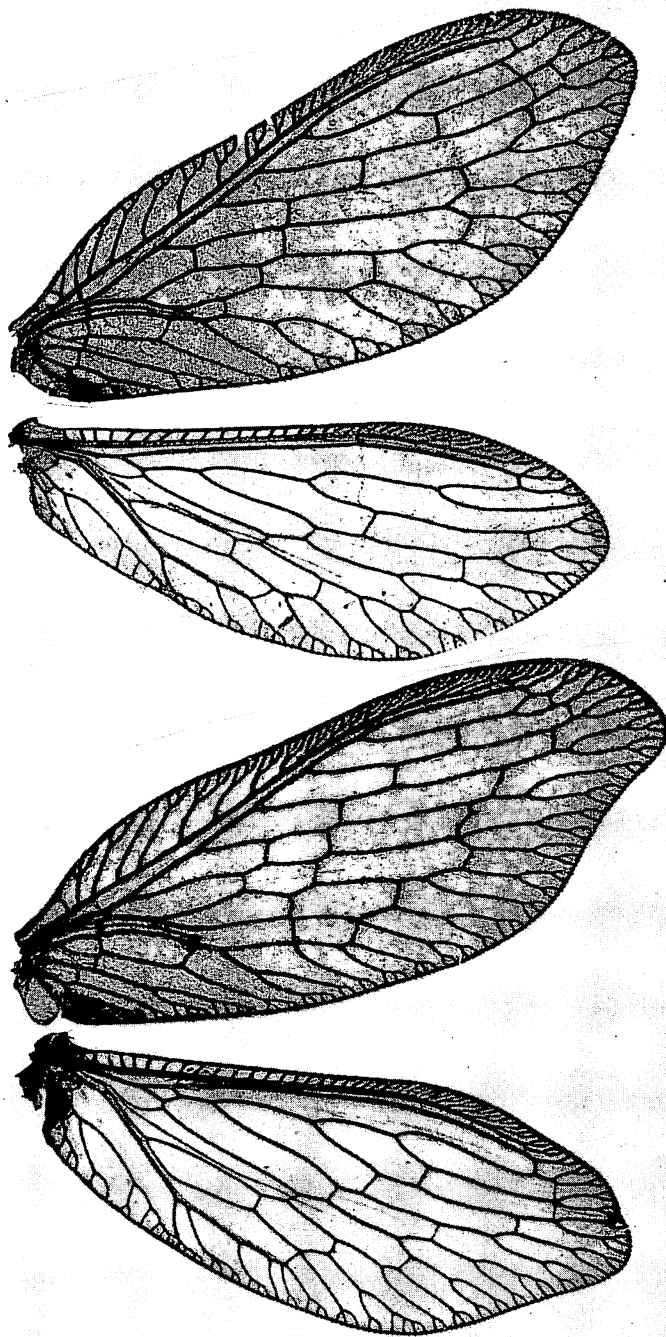


Figure 37—Wings of *Nesomicromus*. Top: *subochraceus* Perkins, holotype; Molokai mountains, 2,000 feet; fore wing length, 6.25. Bottom: *vagus* Perkins, holotype; Kau, Hawaii; fore wing length, 9.25 mm.

It has already been pointed out above that when I dissected the holotype of this species at the British Museum I found numerous remains of the black citrus aphid, *Aphis aurantii*, in the intestines. The holotype was collected by Perkins at Kau, Hawaii, in 1895. This is the earliest record for this aphid in Hawaii; it was not recorded in Hawaiian literature until 1910.

*N. vagus* varies much in size and color, and pale or teneral examples may appear to be different species from dark examples from wet localities. The number of radial sectors in the fore wings may be four, five or six, but the most common number is five.

#### Genus **PSEUDOPSECTRA** Perkins, 1899:46

Zimmerman, 1940:505; 1948:144, 148, 154–157.

This is a remarkable, flightless, segregate group of *Nesomicromus*. It is not monophyletic, but is composed of mutant derivatives of a number of species of *Nesomicromus*. The following genus, *Nesothauma*, is likewise a flightless mutant of *Nesomicromus*. I believe that we have here excellent examples of macro-evolution. We see here clearly displayed examples of simple but drastic mutations which have resulted in the development of new forms which are very distinct from their parental stocks. The mutant characters governing these changes appear to be inherent in the Hawaiian section of the genus *Nesomicromus*, so that perhaps many or all of its members may be subject to giving off progeny which are “hopeful monsters” when certain gene combinations are fortuitously established. When such “hopeful monsters” arise under conditions where there is hope, they may become firmly segregated as new entities. If they succeed in ignoring the handicaps resulting from their greatly altered or lost organs, and can adapt themselves to new environmental strata, they have excellent chances for success in the forests of our islands. The species of this genus and of *Nesothauma* have met the challenge. They are among the marvels of insular creation.

This group is separated from *Nesomicromus* because its members are flightless; the fore wings are reduced in size, generally coriaceous instead of delicate and lace-like, the venation is greatly altered and in some confused and forming a reticulate pattern, and the hind wings are reduced to small or minute fleshy vestiges which bear little resemblance to the organs they represent. The genitalia are typical of *Nesomicromus*.

An independent tendency toward reduction of the hind wings and reticulate venation is displayed by *Cochopterella* Handshin, 1955, from Juan Fernandez. The South American *Gayomyia* has developed a partial reticulate venation near the base of the fore wings. These are examples of parallel evolution, however, and the genera are not related.

In 1940, I pointed out that on the genotype, *Pseudopsectra lobipennis* Perkins, the setae on the wing veins are minute and are difficult to see with a hand lens. This led Perkins to state that the veins were without setae. The setae can be seen with adequate magnification, however. The three species added to the genus since Perkins first characterized it in 1899 show that the wing vein setae in this group

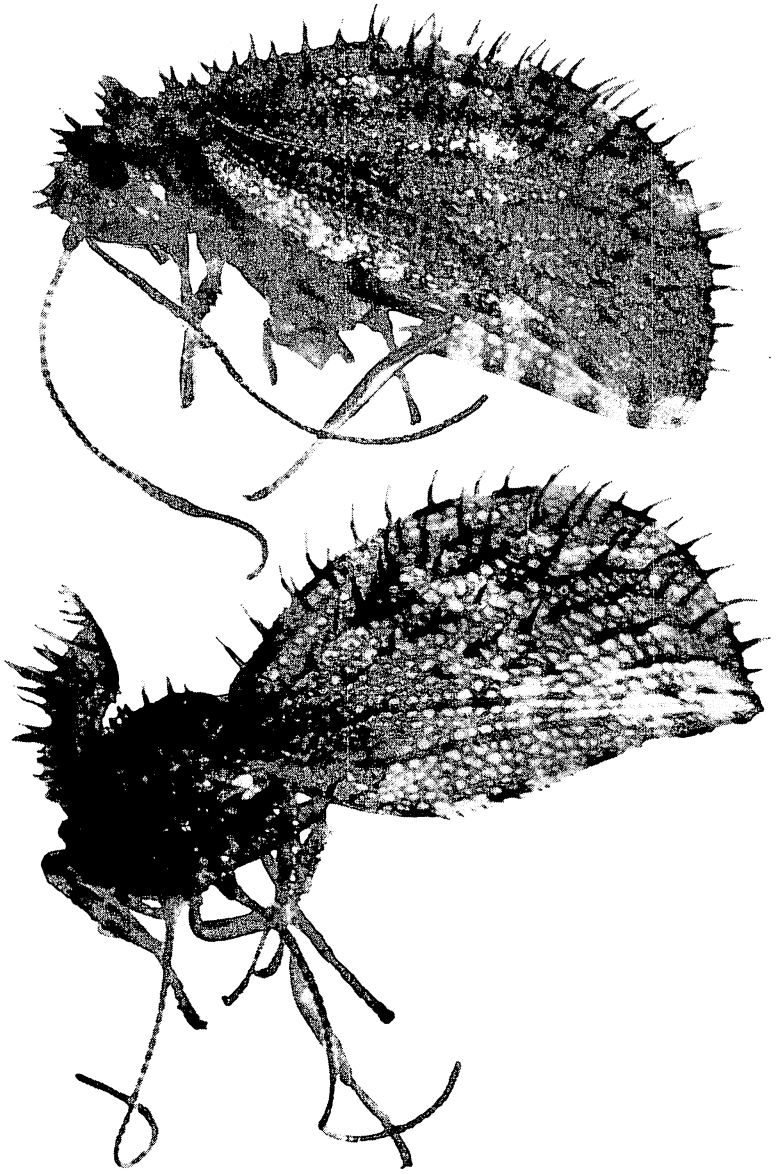


Figure 38—*Pseudopsectra cookeorum* Zimmerman. Holotype male, above; allotype female, below.

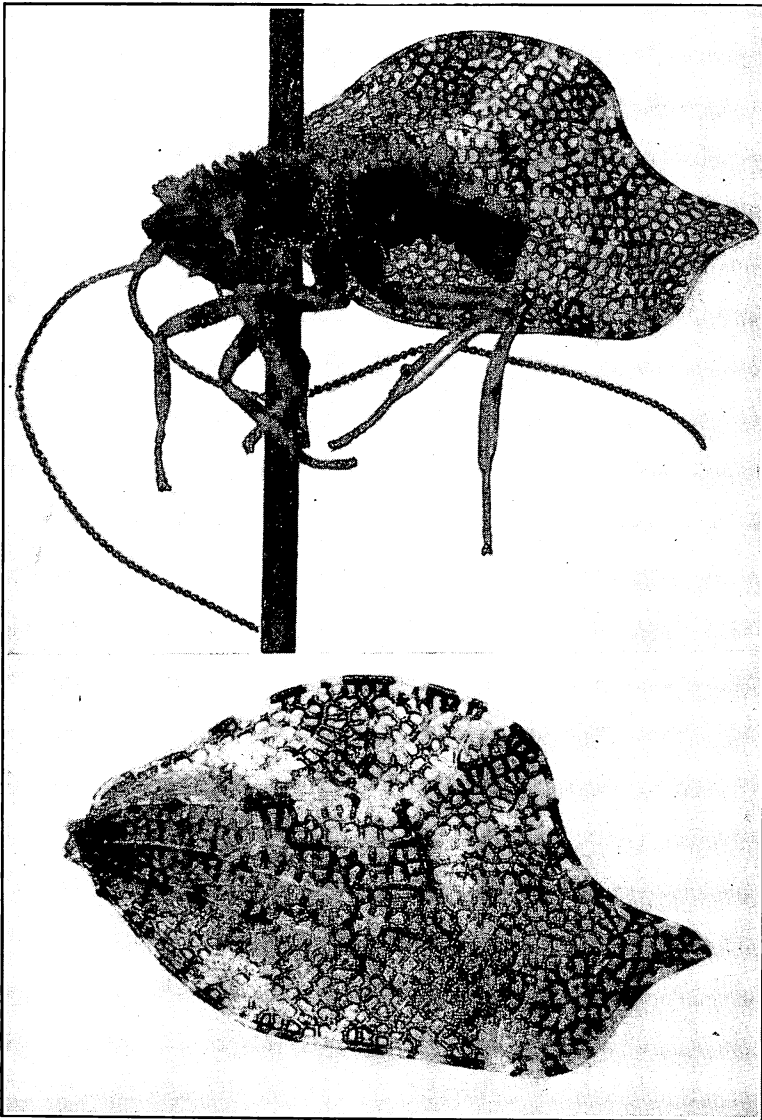


Figure 39—*Pseudopsectra swezeyi* Zimmerman, holotype female.

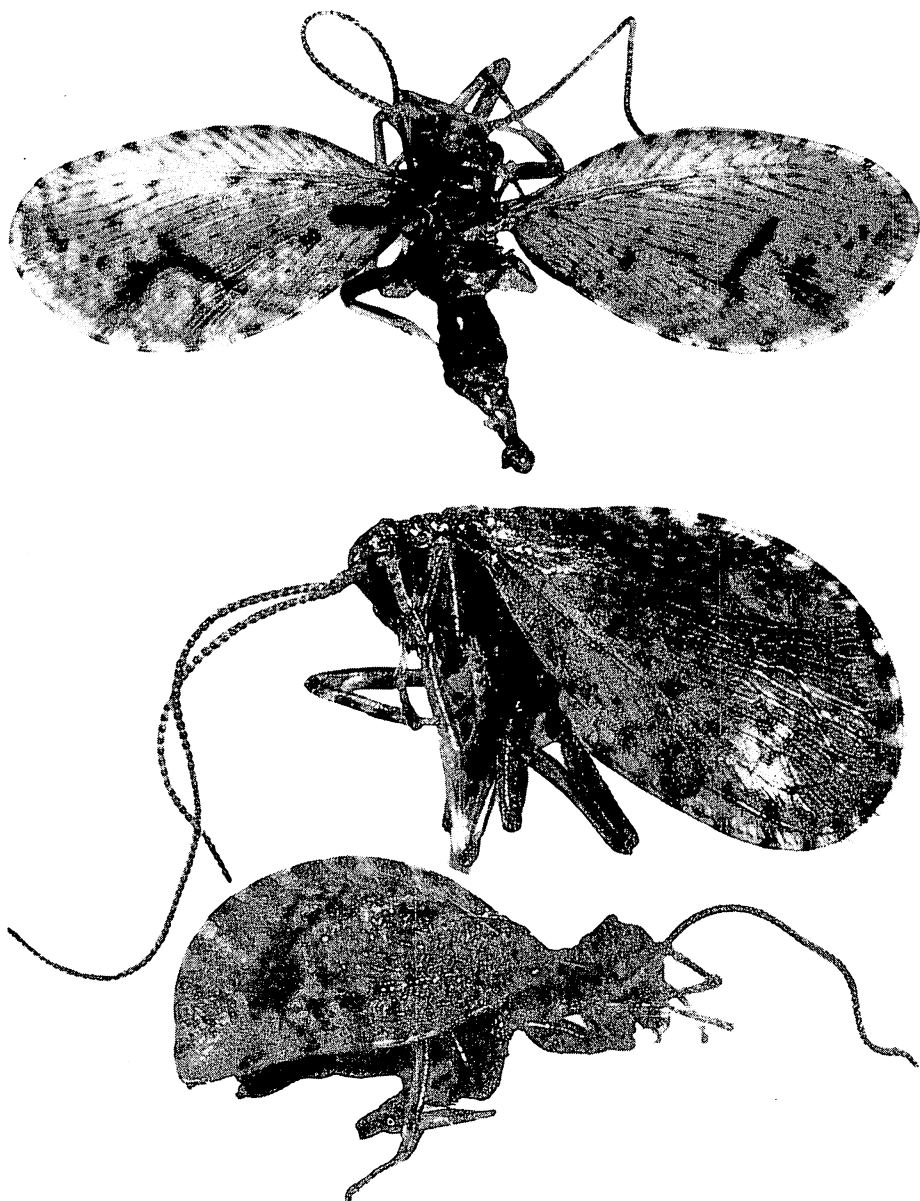


Figure 40—Flightless endemic Hemerobiidae. *Pseudopsectra lobipennis* Perkins, top and middle; *Nesothauma haleakalae* Perkins, paratype, bottom.



range from minute to long, just as they do in the parent *Nesomicromus*; in *Pseudopsectra cookeorum* Zimmerman an extreme development of the setae has occurred (see figure 38 for illustration).

Perkins called this genus "false *Psectra*." *Psectra* is found in North America and Europe. The genotype of *Psectra*, *diptera*, has flightless females and fully winged or flightless males. (Comstock says it is the female that is flightless, Imms says it is the male, and Essig does not mention the interesting fact that the wings may be rudimentary in either sex!)

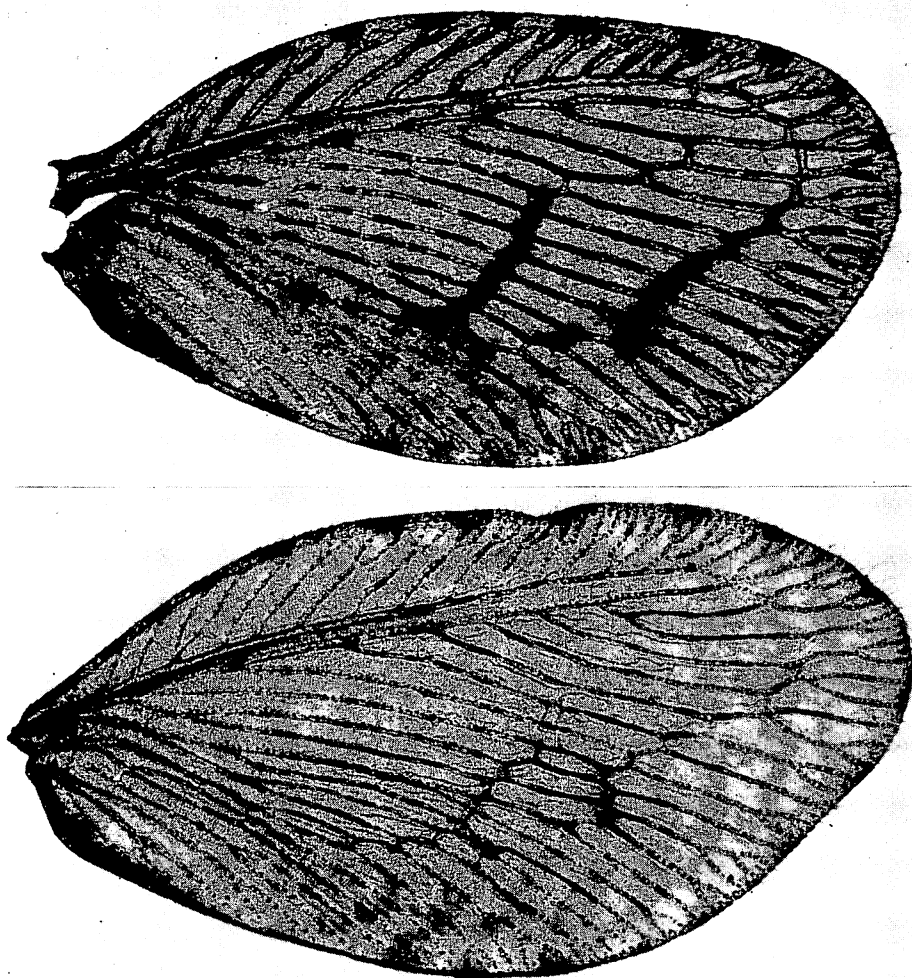


Figure 41—Fore wings of two specimens of *Pseudopsectra lobipennis* Perkins. Top: from the holotype; Haleakala, Maui, 5,000 feet; length, 4 mm. Bottom: an example from Paliku, Haleakala, Maui; length, 4.5 mm. Note the variation in venation.

In the foregoing key to the species of *Nesomicromus*, I have segregated at the first dichotomy species which have the fore wings concave at the apices and those whose apices are not concave. In turn, the species with concave apices are divided into a group which has the posterior margins of the wings sinuous and a group in which the posterior margins are not sinuous. The species of *Pseudopsectra* have been derived from species of *Nesomicromus* which fall in these various categories, as an examination of the illustrations will show. This outstanding feature of the group demonstrates most graphically its polyphyletic origin. The species of *Pseudopsectra* have arisen from different ancestral species of *Nesomicromus* at different times and at different places and show different degrees of divergence and distinctiveness from their parental stocks. Some workers would split these species into more than one genus. I believe that such a course is neither necessary nor desirable. The merging of this genus with *Nesomicromus* would be more appropriate than further splitting.

For 40 years from the time of its description, this genus remained monotypic. In 1940 I described two new species, one of which had been collected on Kauai by O. H. Swezey in 1921, the other captured by R. L. Usinger on Hawaii in 1935. In 1946 I added a fourth species, which I found on Maui in 1945. J. C. Bridwell told me that many years ago he had collected several specimens of a new species on Mount Kaala, Oahu, but that he lost the vial containing the specimens during the difficult descent from the precipitous mountain. Drs. O. H. Swezey and F. X. Williams, who were with Bridwell at the time, remember the incident. There are new species to be discovered and described, and perhaps many species still await the skilled and fortunate collector in the depths of our remnants of native forest. They are rare and obscure and easily overlooked animals which will not be found

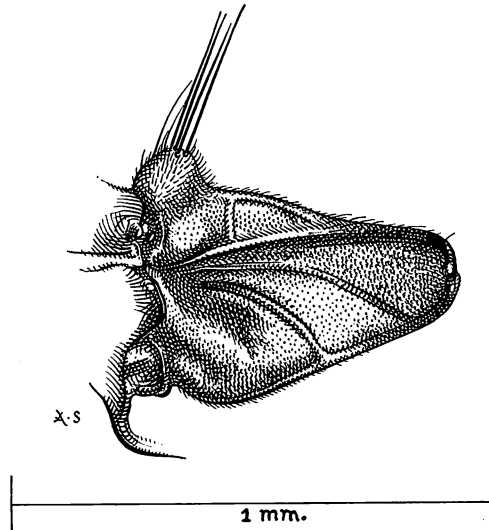


Figure 42—Ventral view of the greatly reduced left hind wing of *Pseudopsectra lobipennis* Perkins. (From an example collected by me near Puu Luau, Haleakala, Maui.)

easily. Species have been found on Kauai, Oahu, Maui and Hawaii. Molokai should yield some fine species, and the other islands certainly must have more species.

We cannot anticipate what astonishing evolutionary products will be discovered in this group when further careful collecting is done. Such collecting is greatly needed. Our flora and fauna have been disappearing with astonishing rapidity. Hundreds of species are already extinct, and extinction processes continue.

Handschin, the well-known Swiss entomologist in Basel, has recently published a report on the Neuroptera of the Juan Fernandez Islands, off the middle coast of Chile (1955:3). He comments upon my work on the Hawaiian Hemerobiidae as follows (translated from the German):

In 1939, Zimmerman described from Kauai (Hawaiian Islands) a form close to *Gayomyia falcata*, *Pseudopsectra swezeyi*, which also is distinguished by strongly falcate wings and an archaediclyon extending over the whole wing. According to the form and venation the species has probably nothing to do with *P. usingeri* described at the same time. The only common character would be the absence of the hind wings. However, it should be seen in connection with *P. cookeorum* Zimmerman, described in 1945. Together these two forms, which in my opinion each must be regarded as a separate genus, point to a connection with *Gayomyia* in which also the archaic character of the archaediclyon is preserved. *P. cookeorum* in turn is close to *Nesothauma*, so that it must be compared with this genus in the first place and not with *Psectra* with which form it shows only accidental similarity only in the absence of the hind wings.

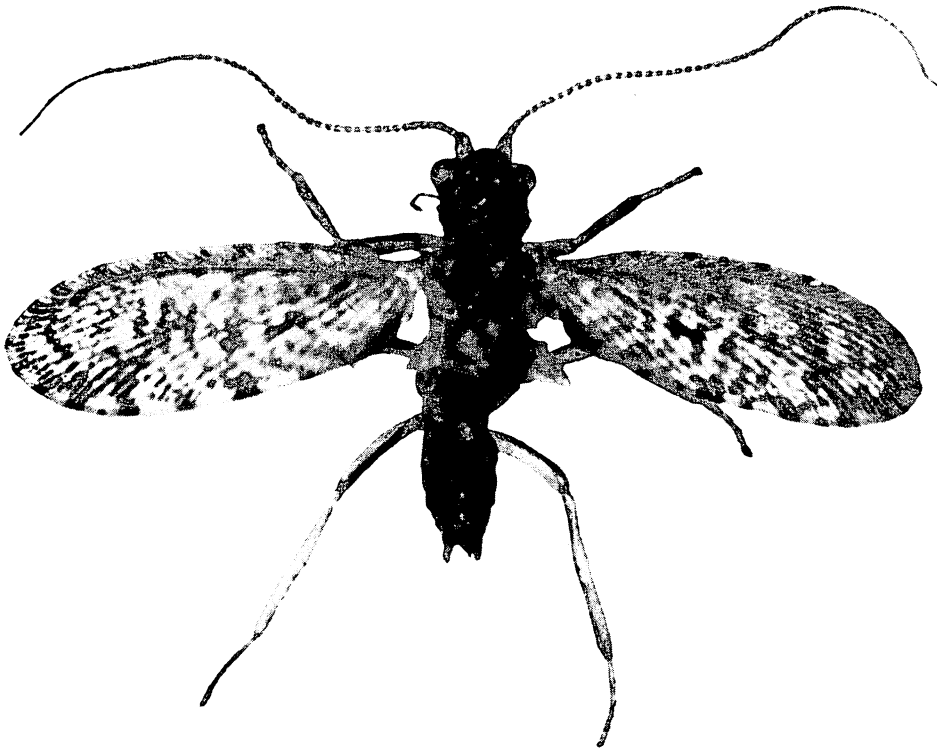


Figure 43—*Pseudopsectra usingeri* Zimmerman, holotype.

Unfortunately, my friend Dr. Handschin has not seen the Hawaiian species and has written a misleading paragraph. He says that *Pseudopsectra* have no hind wings, but all the species do have hind wings. The Hawaiian species have absolutely nothing to do with the Juan Fernandez insects, as an examination of the genitalia alone will reveal in a moment. No one has related or compared to *Psectra*, in the way Handschin infers, any *Pseudopsectra*. The name "false *Psectra*" was chosen by Perkins when he erected the genus, because *Psectra* contains the only flightless form known to him. I believe that an examination of the illustrations presented herewith clearly demonstrates the inter-relationships of *Nesomicromus* and the flightless Hawaiian derivative species. If one would follow Handschin and separate the flightless forms into several genera based upon wing shape and degree of reticulate venation, then one would probably wish to create a separate genus for each of the known flightless species—a course which I consider misleading and untenable. The characters blend from one extreme to another. As a matter of fact, I am not at all certain but that it would be best to place all of the species of *Pseudopsectra* in *Nesomicromus*. *Pseudopsectra* is not a monophyletic group, and the only structures in which it differs from *Nesomicromus* are the wings. In many other groups of insects, flightless and fully winged species are placed in the same genera. If these insects are to be split into genera, then I believe that

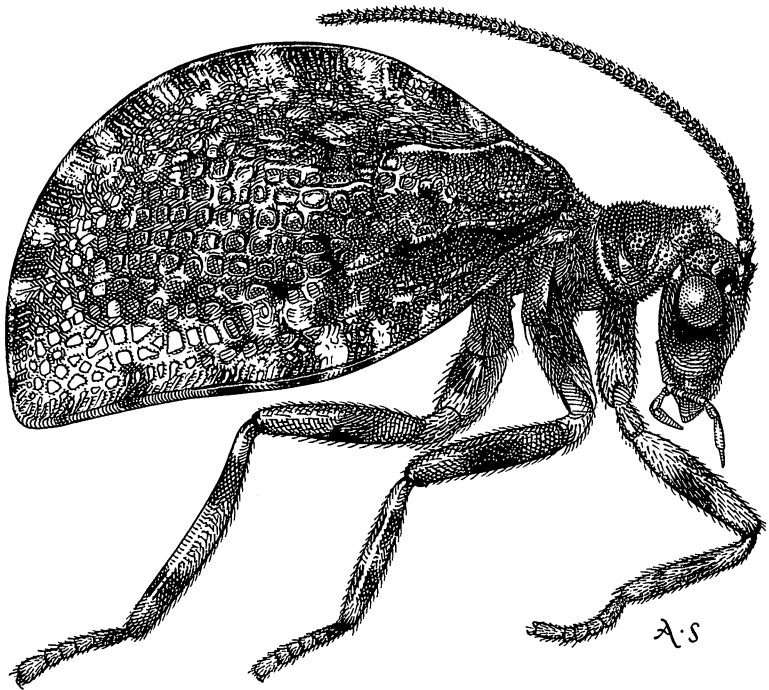


Figure 44—One of the marvels of creation in Hawaii. *Nesothauma haleakalae* Perkins, allotype female; Haleakala, Maui, 5,000 feet. Total length, 4 mm.; one inch on the figure equals 1 mm. There are no traces of hind wings on this species.

it must be demonstrated that they have other fundamental structural differences of generic importance in addition to the variously modified wings. Let us not forget the wide range of type of wings in the parent *Nesomicromus*. The structure of the body, legs and genitalia in all of these species is generically similar; it is only the wings that differ. Handschin, after an examination of my illustrations, would separate, generically, *cookeorum* and *swezeyi*. But what characters of generic

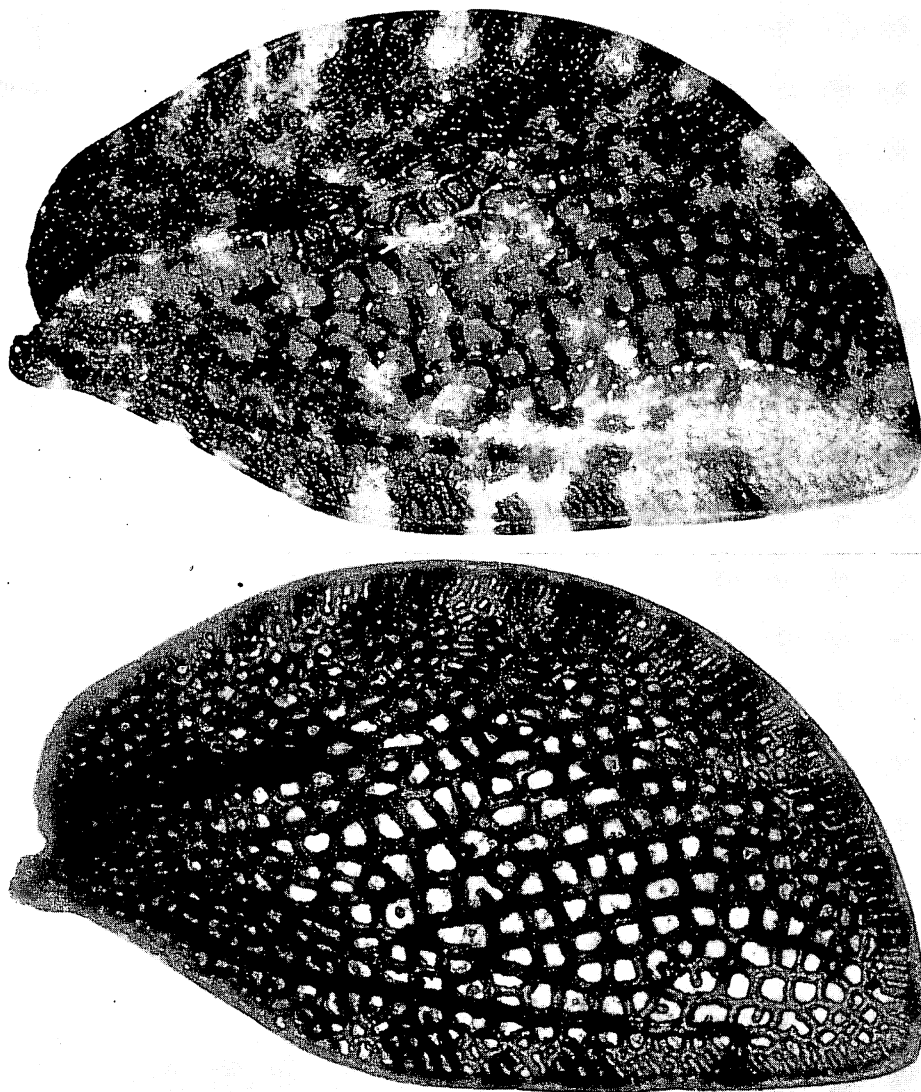


Figure 45—*Nesolhauma haleakalae* Perkins. Left fore wing of allotype female. The upper photograph was made with mostly reflected light; the lower was taken with strong transmitted light to reveal the venation.

nature are displayed by these species? The difference in wing shape is merely a reflection of the similar differences in the ancestral *Nesomicromus*, and this is an inherent character which is produced with a variable amount of intensity in various species. Handschin considers the network of veins on these two species to show relationship with the Juan Fernandez *Gayomyia*, but he has become confused by independent development and parallel evolution. Most certainly, there is no "archaeic archedictyon" *preserved* in these Hawaiian species. The secondary thickening and reticulate nature of the venation has nothing to do with archedictyon, and it appears that Dr. Handschin is confusing this purely modern development with a primitive type of structure found in ancient insects only.\*

#### KEY TO THE SPECIES OF PSEUDOPSECTRA

1. Apical margins of fore wings concave and posterior margins strongly sinuous; Kauai. . . . . **swezeyi** Zimmerman.
- Apices of fore wings rounded, posterior margins convex and not sinuous. . . . . 2
- 2(1). Fore wings with setae on veins greatly enlarged into long, conspicuous, bipartite spines; Maui. . . . . **cookeorum** Zimmerman.
- Fore wing vein setae either small, obscure and fine, or long, fine and hair-like. . . . . 3
- 3(2). Setae of fore wing veins very small and difficult to see; fore wings broad, few cross-veins between the branches between R and Sc and none between Sc and C; Maui. . . . . **lobipennis** Perkins.
- Setae on fore wing veins long and prominent, the wings appearing densely hairy; fore wings comparatively narrow, numerous cross-veins between the branches between R and Sc and Sc and C; Hawaii. . . . . **usingeri** Zimmerman.

***Pseudopsectra cookeorum* Zimmerman (fig. 38).**

*Pseudopsectra cookeorum* Zimmerman, 1946:659, fig. 1; 1948:155, fig. 49.

Endemic. Maui (type locality: just inside the west rim of the summit of Haleakala Crater at about 9,700 feet elevation).

This spiny "monster" is a most distinctive species. The reticulate network of

\*"In the wings of certain of the most generalized insects, such as the fossil Palaeodictyoptera, an irregular network of veins is found between the principal longitudinal veins, but no definite cross veins are present. To this primitive meshwork Tillyard (1918) has given the name *archedictyon*. It appears to have undergone suppression in the Holometabola, though it is very probably homologous with the still-existing dense reticulation present in certain orders of Exopterygota such as Odonata." Imms.

supernumerary wing veins resembles that of *Pseudopsectra swezeyi*. The extraordinary development of the setae on the wing veins, head and thorax is remarkable. The setae are bipartite and consist of an elongate, stout, rod-like base from the apex of which projects a strongly developed seta.

I was able to discover only one male and one female of this species in spite of prolonged search at the type locality; the types were found on *Dubautia*.

***Pseudopsectra lobipennis* Perkins (figs. 40; 41; 42; 46, a-d). Type of the genus.**

*Pseudopsectra lobipennis* Perkins, 1899:46, pl. 4, fig. 12. Zimmerman, 1948:154, fig. 48.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Perkins collected one pair of this species in March, 1894. P. H. Timberlake collected it from ferns in a gulch near Puu Nianiau, from *Metrosideros* near the edge of the forest near Keanae Pali and from *Cyanea* near the edge of the forest

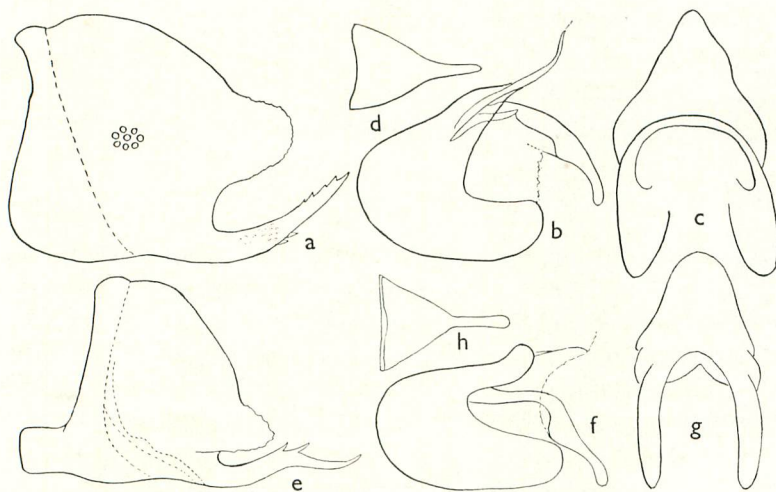


Figure 46—Male genitalia of *Pseudopsectra* and *Nesothauma*. a-d, *Pseudopsectra lobipennis* Perkins, holotype: a, valve; b, lateral view of tenth sternite and aedeagus; c, dorsal view of tenth sternite; d, dorsal view of apical part of aedeagus. e-h, *Nesothauma haleakalae* Perkins, holotype: e, valve (the basal part of the ninth tergite, fused with the tenth is very heavily sclerotized, and the trichobothria appear to be wanting); f, lateral view of tenth sternite and aedeagus; g, dorsal view of the tenth sternite; h, dorsal view of apical part of aedeagus. All to same scale.

at 5,800 feet—possibly near Puu Luau. I collected a series of specimens in 1938 and later in the Olinda Forest area along the Kula Pipe Line Trail, along the upper margin of the Olinda Forest near the transition to the upper grassy pasture land, and on *Myrsine*, near Puu Luau. One example was taken by D. E. Hardy at Paliku in June, 1952.

This is the least divergent of all species of known *Pseudopsectra*. It is most like *usingeri*, but its fore wings are much broader, and the veins appear to be bare

(but they have minute setae, and the wing margins are fringed with long hair). The venation is distinct and comparatively little modified and is not confused by a reticulate pattern of supernumerary veins and cross-veins. There are seven, eight or nine radial sectors in the fore wings of the specimens I have seen. The vestigial hind wings are better developed in this species than on the others.

The male holotype had its alimentary canal packed with the remains of apterous aphids, but I could not identify the species, which seemed to belong to *Aphis*.

***Pseudopsectra swezeyi* Zimmerman (fig. 39).**

*Pseudopsectra swezeyi* Zimmerman, 1940:508, fig. 2.

Endemic. Kauai (type locality: Nualolo).

This is one of the most remarkable products of Hawaiian evolution. Its sinuous-margined, pointed fore wings with their dense, reticulate pattern of supernumerary veins and cross-veins are distinctive. They bear microscopical setae. The thorax is studded with numerous, long, prominent, sharply pointed, cone-like tubercles. Only the unique female holotype is known.

***Pseudopsectra usingeri* Zimmerman (fig. 43).**

*Pseudopsectra usingeri* Zimmerman, 1940:506, fig. 1.

Endemic. Hawaii (type locality: Humuula area).

Hostplant: *Sophora*.

Dr. Usinger collected one male and one female of this species; no others are known. It, like Perkins' *lobipennis*, is less divergent than our other known species. Its fore wings, however, are more compacted, the veins are heavy and a large number of supernumerary cross-veins give the surface a coarse, reticulate pattern which shifts the development of these organs in the direction more fully taken by *cookeorum* and *swezeyi*. The numerous long, fine hairs and setae are distinctive.

Genus **NESOTHAUMA** Perkins, 1899:46

Zimmerman, 1940:510; 1948:157.

This genus was erected for an offshoot of *Nesomicromus* which has lost all trace of hind wings. The antennae are shorter than the fore wings. If it were not for the shorter antennae, it appears that the genus would best be merged with *Pseudopsectra*. The antennae of *Nesothauma* have 50 segments, those of the type of *Pseudopsectra lobipennis* have nearly 80, and those of the type of *Nesomicromus vagus* have about 65. The number of segments is subject to some variation between species and individuals in *Nesomicromus*. The size of the hind wings varies in the species of *Pseudopsectra* from minute vestiges to small, cordate lobes which contain rudimentary veins. The extreme is exhibited by *Nesothauma*, on which no external evidence of hind-wing remnants can be found. The fore-wing texture of *Pseudopsectra* ranges from that of least-modified *lobipennis* to most extreme *swezeyi*,



which approximates that of *Nesothauma haleakalae*. With this variation in wing structure, we might also expect to find a range of variation in the development of the antennae; but in all four described species of *Pseudopsectra* the antennae are of similar development and are longer than the fore wings. The antennae of *Nesothauma* are definitely shortened. The genitalia are similar in all three genera.

***Nesothauma haleakalae*** Perkins (figs. 40; 44; 45; 46, e-g). Type of the genus.

*Nesothauma haleakalae* Perkins, 1899:47, pl. 4, figs. 13, 13a, 13b. Zimmerman, 1940:510; 1948:157, fig. 48.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

This small (4 mm.) species has been collected only by Dr. Perkins, who took a few specimens in March, 1894, and October, 1896, probably in what is now the Olinda Forest Reserve, and it has escaped notice since. In its natural position, this little insect superficially resembles a large, dark, heavily sclerotized psychodid fly. There is considerable variation in color of the wings; most examples have the wings tessellated, but some have more black than others. The wings are strongly and conspicuously angulate in the basal quarter and overlap the abdomen for about one-half their lengths. It is difficult to trace the veins because of the heavy texture and the supernumerary cross-veins. The entire wings are so coarsely reticulate as to recall the formations found on many tingid bugs. The anterior margin of the pronotum is conspicuously emarginate at the middle. The mesonotum, pronotum and crown of head are densely covered with small tubercles. Except for a few hairs near the base, the wings seem to be nude; but under high magnification and adequate light, very short, microscopical setae can be seen. The abdominal sternites and parts of the male genitalia are more heavily sclerotized than those of any other Hawaiian Hemerobiidae yet known.

Family CHRYSOPIDAE Hagen, 1866  
Green Lacewings, Chrysopids, Golden Eyes

Two genera and 24 species and subspecies represent this family in Hawaii, as compared to 5 genera and 27 species in the Hemerobiidae. In England there are also 2 genera, but only 14 species, according to Killington (1937:149). Kimmins (1952:80) listed 44 species in 9 genera for Australia and Tasmania. The family evidently is not represented in the native New Zealand fauna—a most interesting fact. Oligocene fossils are known from some places. I do not know of any other Polynesian fauna which has anywhere near the speciation of the Hawaiian group. The widespread genus *Chrysopa* is represented in Hawaii by two introduced species. Our 22 other forms are all endemics and belong to the fine endemic genus *Anomalochrysa*. Unlike our Hemerobiidae, the Hawaiian Chrysopidae have remained conservative in their major evolutionary processes, and they have not developed any unusual, divergent groups.

The Hawaiian chrysopids are larger than our hemerobiids and range from about 20 to 45 mm. in expanse. In color they range from delicate green to dark brown, and the body may be brightly marked in life. The beautiful and often striking colors of the body usually fade upon drying, and museum specimens have nothing like the delicate beauty of the living creatures. The wings range in color from very pale green or hyaline to those with reddish or brownish suffusion or maculation; some have a milky suffusion. The veins may be much darker than the membrane and stand out prominently. Eyes large, prominent, shining golden, metallic-like in life; ocelli absent. Antennae long, filiform. Fore and hind wings of similar general shape and pattern, held roof-like over the body when at rest, radius with only one sector, the veinlets in the area between costa and subcosta not branched, or none branched before the middle of the costa. The wing membrane has no microtrichia and there are no trichosors, but the veins, cross-veins and margins have numerous setae (macrotrichiae).

Some chrysopids have specialized glands in the prothorax from which they can emit an offensive-smelling, repugnatory fluid. Thus, in some countries, chrysopids are called "stink flies." Kennett (1948) has reported that the larva of *Chrysopa californica* Coquillett, when attacked by ants, exudes a repugnatory fluid from the anus and tries to smear it on the head of the attacking ant. The fluid is an effective repellent, and if a quantity of the material is placed upon an ant, the ant may become paralyzed for as long as 15 minutes.

The elongate-ovate eggs of many species, including one of our *Chrysopa* species, are raised from the substratum on which they are laid by remarkable, long, thread-like stalks (see figures). The eggs of our endemic *Anomalochrysa* are not stalked, but are deposited on their ends—sometimes several in a group. The micropyle on the *Anomalochrysa* eggs is a low, button-like protuberance. I am unable to supply information regarding the sculpturing of the surface of the eggs of our species. When laying the stalked eggs, the female *Chrysopa* touches the apex of her abdomen to the substratum, usually a leaf, exudes a viscous fluid,

and then elevates her abdomen and draws out a thread several millimeters long, upon the end of which she attaches her egg. This is a protective mechanism, for it raises the eggs out of the range of certain enemies which hunt on leaf surfaces. The delicate stalk is not easily climbed. Stalked eggs are found also in the Mantispidae and Berothidae, families of Neuroptera which do not occur in Hawaii.

The embryos are equipped with well-developed, dentate egg-bursters. The larvae are usually stouter than those of the Hemerobiidae and have more protuberances and more setae. There are six facets in the eyes. The antennae are three-segmented, but the joint between the second and third segments may be nearly obsolete. Mandibles arcuate, long and slender, somewhat longer than the head. Labial palpi four-segmented. The body may appear nearly smooth or may be setose and tuberculate, and the tubercles bear tufts of setae; the derm is covered with microtrichiae. The larvae of one of our species of *Chrysopa* carry debris upon their backs, as will be discussed later, but the other *Chrysopa* and *Anomalochrysa* larvae do not have that habit. The debris-carrying larvae have numerous hooked setae and setae tufts on the dorsum and these hold the loads of debris in place. The articulation between tarsus and tibia is partly fused. In all stages there is a trumpet-shaped empodium between the paired tarsal claws. Abdomen 10-segmented, anal segment adhesive, equipped with a pair of eversible pads; spiracles on segments one to eight. A parchment-like cocoon is spun from silk from the anus.

The internal anatomy of the Hawaiian species has not been studied, but it should offer some interesting features. The larvae of chrysopids are said not to differ greatly from larval Hemerobiidae in gross structure. The internal anatomy of the adults presents more differences. In those species equipped with stink-glands, the organs lie in each side of the prothorax and open dorsally behind the head. The following material is abstracted from Withycombe (1923): Each salivary gland extends back along the side of the oesophagus to the rear of the prothorax, then turns forward to the anterior part of the prothorax where it branches into diverticula which intertwine above the oesophagus with the diverticula of the gland on the opposite side. The testes are separate, contained in a yellow scrotum, and they frequently present distinctive differential characters. Only one cement gland is fully developed in the female, the other is rudimentary. Six of the eight Malpighian tubules are attached posterior to the hind gut, and the other two have free ends.

Chrysopidae feed as larvae, and usually as adults, on a variety of arthropods, and it is of interest that so many of the organisms they feed upon are pests of plants utilized by man. Chrysopids feed on various mites and "red spiders" and their eggs, and on the eggs and immature and adult stages of aphids, psyllids, mealybugs, scale insects, psocids, cicadellids, delphacids and other fulgoroids, Lepidoptera and other insects. They are perhaps best known for their aphid-eating habits. They are of real importance in aiding in the biological control of many crop pests.

The Hawaiian Chrysopidae may easily be distinguished from our other Neuroptera because of their size and shape and their usually green color alone. Some

of the smaller species approach certain of our Hemerobiidae in size, but the wing venation is so very distinct that no confusion of the groups is possible. An examination of the illustrations will quickly familiarize the student with the gross diagnostic features of this family.

Perkins collected the species with such care and skill that no new ones have been described since he completed his studies in 1899. The combined collections made by all the collectors in Hawaii during more than the past half century are not as rich in species as Perkins' collection alone. It appears that our native chrysopids have become much rarer in recent years. The Rev. Blackburn, who made the first extensive insect collections in Hawaii, stated (1884:418): "This family is richly represented in the Hawaiian archipelago, and probably there are scores of distinct species. I think that I have met with examples on every island, and in all kinds of localities, often in considerable abundance."

The two species of *Chrysopa* are known to be attacked by an introduced wasp. I have no record of a parasite from any *Anomalochrysa*, although these native species may also be attacked.

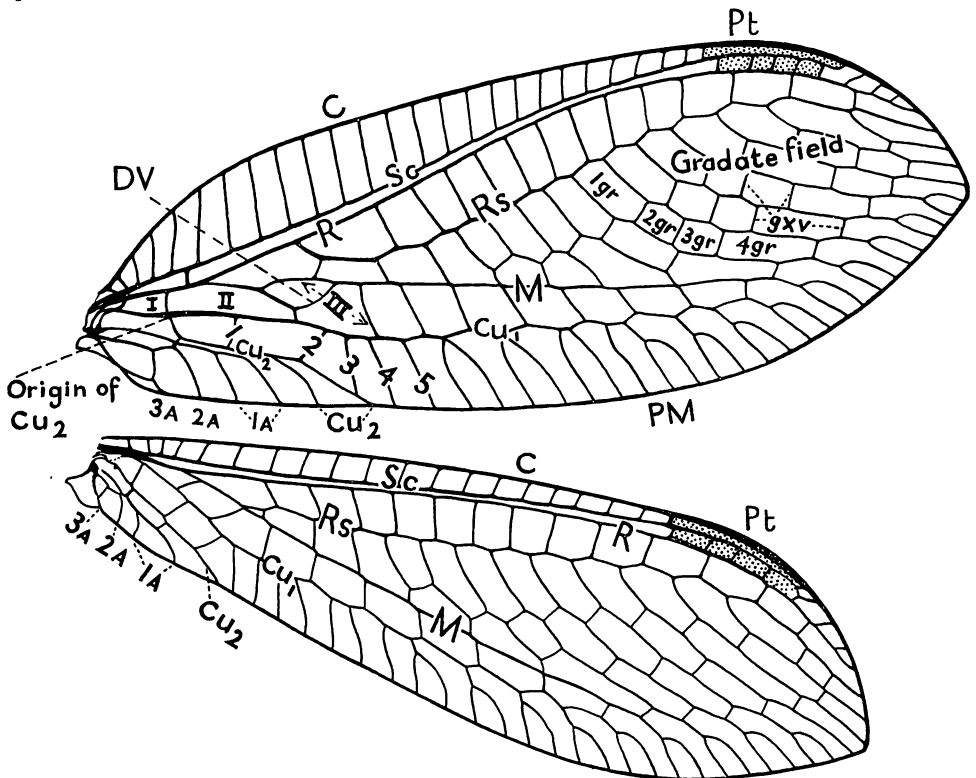


Figure 47.—Wings of *Anomalochrysa viridis* Perkins, type, labeled to show some of the parts used in classification. C, costa; Cu<sub>1</sub> and Cu<sub>2</sub>, main branches of cubitus; DV, dividing nervure or cross-vein of the third cubital cell; gxv, gradate cross-veins; M, medius; PM, posterior margin; Pt, pterostigma; R, radius; Rs, radial sector; Sc, subcosta; 1A, 2A, 3A, first, second and third anal veins; 1gr to 4gr, first to fourth series of gradate cells; I, II, III, first, second and third cubital cells (the third cell is divided into two cellules by DV); 1, 2, 3, 4, 5, first to fifth cross-veins from Cu<sub>1</sub> beyond the origin of Cu<sub>2</sub>.

## KEY TO THE GENERA OF CHRYSIDAE FOUND IN HAWAII

- Fore wings with only two series of gradate cells between Rs and M. . . . . **Chrysopa.**  
 Fore wings with three or more series of gradate cells between Rs and M. . . . . **Anomalochrysa.**

Genus **CHRYSOPA** Leach, 1815:138

The two representatives of this nearly world-wide genus in Hawaii are adventive. They have a distinctive facies which makes their separation from *Anomalochrysa* fairly simple, and a glance at the wings will quickly reveal the presence of only two series of gradate cells between the radial sector and media which makes identification positive. They are generally smaller than our *Anomalochrysa*, ranging in expanse from about 19 to 25 mm., whereas the *Anomalochrysa* species range in size from 23 to 45 mm., mostly over 30 mm. in expanse.

One of our species is an accidental immigrant from South America. The source of the other is undetermined. They are now widespread insects in Hawaii. The larva of one species covers itself with debris, but the larva of the other does not have such a habit. The adults of both species are attracted to lights, especially on warm, still, summer nights.

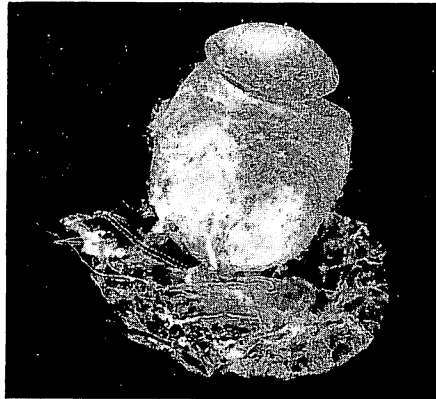


Figure 48—Chrysalis shell on cocoon of *Chrysopa lanata* Banks. Length of chrysalis shell, 5.5 mm. Example from Honolulu.

## KEY TO THE SPECIES OF CHRYSOPA FOUND IN HAWAII

- Fore wings with the dividing nervure of the third cubital cell joining M at or (usually) basad of the first cross-vein between M and Rs; hind wings with subcosta and radius distinctly separate before pterostigma in both sexes. . . . . **lanata** Banks.  
 Fore wings with the dividing nervure of the third cubital cell joining M distad of the first cross-vein between M and Rs; hind wings with subcosta fused with radius for a distance basad of pterostigma in male. . . . . **microphyia** McLachlan.

In addition to these two species, a third, *Chrysopa oceanica* Walker, 1853 (*Chrysopa v-rubrum* Brauer, 1866), has been recorded from Hawaii, but there is reason to believe that the record is erroneous. Perkins (1899:36, footnote) said: "We have excluded the *Chrysopa oceanica* Walk. from the list as probably not belonging to the Hawaiian fauna. Several species brought home by the Beechey expedition with the locality 'Sandwich Is.' appear to have come from the other islands of that name." *Chrysopa oceanica* is a common species widespread, at least from the New Hebrides to the Society Islands, in the south Pacific. In my previous report on the Hawaiian *Chrysopa* (1940:490), I have given a key to separate it from the two species now known to be established in Hawaii.

***Chrysopa lanata* Banks (figs. 48; 49; 52, b-d).**

*Chrysopa lanata* Banks, 1910:154. Zimmerman, 1940:489.

Kauai, Oahu, Molokai, Maui, Lanai, Hawaii?, Pearl and Hermes Reef, Midway Kure (Ocean).

Immigrant. Described from Mendoza, Argentina; widespread in South America in Argentina, Brazil, Chile, Peru and to Easter Island. First found in Hawaii at Honolulu by P. H. Timberlake in 1919 (*Proc. Hawaiian Ent. Soc.* 4:361, 1920).

Hosts: aphids, eggs of *Laphygma exempta* (Walker) [*Spodoptera mauritia* (Boisduval)] in earlier Hawaiian literature], *Neophyllaphis araucariae* Takahashi, *Aphis maidis* Fitch, *Aphis sacchari* Zehntner.

Parasite: *Gelis tenellus* (Say) (Hymenoptera: Ichneumonidae), in the pupa.

The adults are paler green and more delicate than those of *Chrysopa microphya*, and the wing veins are weaker. In the fore wings the dividing nervure of the third cubital cell normally joins M basad of the first cross-vein between M and Rs, but on an occasional specimen it joins M at the cross-vein. In all the other Chrysopidae known in Hawaii, the dividing cross-vein joins M distinctly distad of the first cross-vein between M and Rs.

Timberlake, in the reference just cited, said that the adults observed by him fed freely upon honeydew and that they did not eat aphids. Further observations are desirable.

The larvae, unlike those of *Chrysopa microphya*, do not cover themselves with debris. The white, spherical cocoons are, likewise, not covered with debris. Furthermore, this species does not lay stalked eggs as does *microphya*.

Although Hawaiian material has been determined by Banks, the author of the species, it may be worth while checking the determination again and comparing the genitalia.

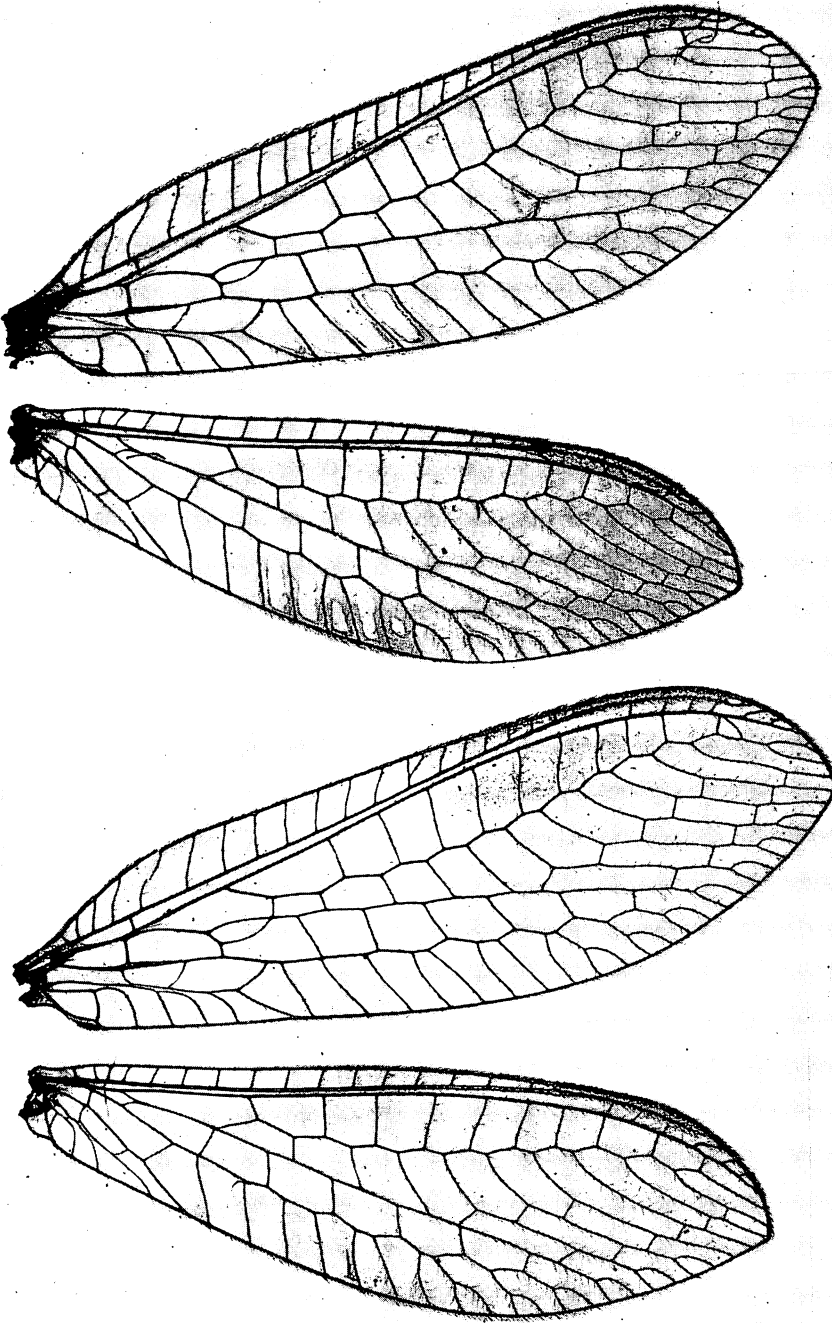


Figure 49—Wings of *Chrysopa lanata* Banks. Note the variation in the position of the apex of the dividing cross-vein of the third cubital cell. The upper figure is from a Honolulu example; fore wing length, 12 mm. The lower figure is from an example from Paia, Maui; fore wing length, 11 mm.

***Chrysopa microphyta* McLachlan (figs. 50; 51; 52, a).**

*Chrysopa microphyta* McLachlan, 1883:300. Terry, 1905:175, pl. 10, figs. 1-4. Williams, 1931:130, fig. 50. Zimmerman, 1940:490.

Kauai, Oahu (type locality: "near Honolulu"), Molokai, Maui, Lanai, Hawaii.

Immigrant. Described from the Hawaiian Islands, but widespread in Polynesia and Micronesia, although not recorded there under this name. It has been misidentified in certain extra-Hawaiian literature, and it may prove to have been described earlier. It was first found here by Blackburn, who reported it to be "Not uncommon near Honolulu." Specimens taken by Miss Cheesman on Faka-rava, Tuamotu Archipelago, were determined as this species with question. Mr. Kimmins has recently told me that a re-examination of the Cheesman material shows that the species involved is not *microphyta*. The Lanai record above is new and is based on material collected by N. L. H. Krauss in the Lanai mountains, November 7, 1947.

Hosts: aphids, mealybugs, scales, mites, *Aphis citricidus* (Kirkaldy), *Aphis sacchari* Zehntner, nymphs of *Hevaheva* (Psyllidae), nymphs and eggs of *Perkinsiella saccharicida* Kirkaldy, nymphs of *Siphanta acuta* (Walker), *Toxoptera aurantii* (Boyer de Fonscolombe).

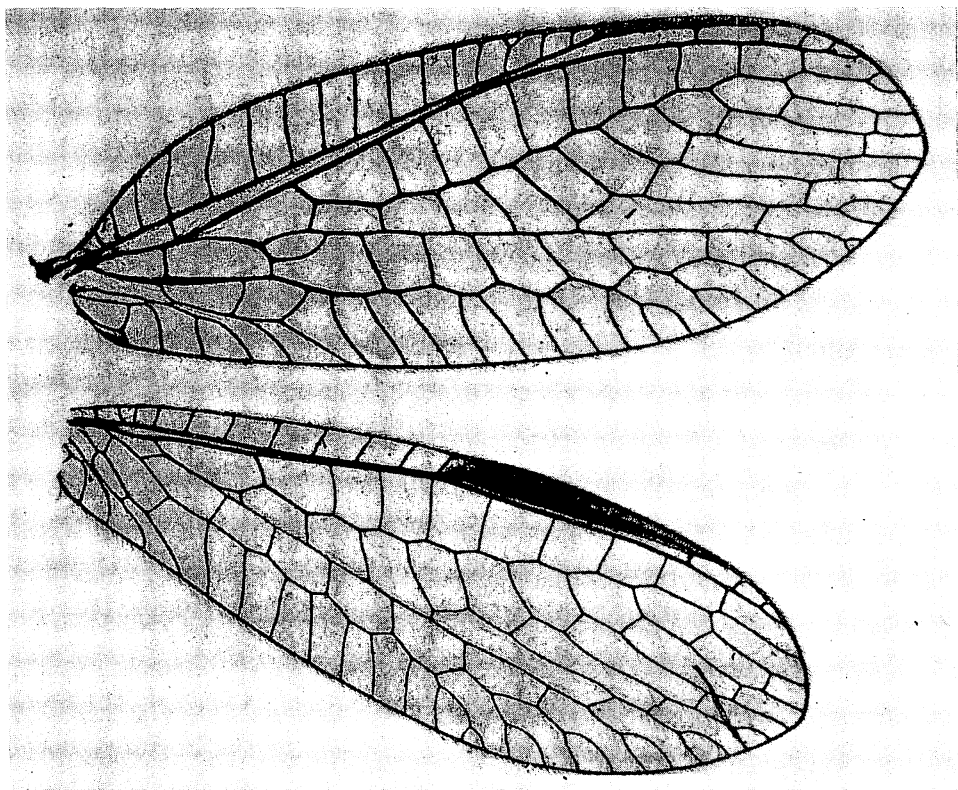


Figure 50—Wings of *Chrysopa microphyta* McLachlan; Kaala mountains, Oahu; fore wing length, 10 mm.; a male showing the fusion of the Rs and M in the hind wing and development of the pterostigma.



Parasite: *Gelis tenellus* (Say) (Hymenoptera: Ichneumonidae) heavily parasitizes the pupae on occasion.

The following biological data are taken mostly from Terry (1905): The eggs are about 0.75 mm. long and fastened to the edges of delicate, hair-like stalks 4 to 5 mm. long. When first deposited they are green, but, as the embryo develops, the color changes to yellowish. They are usually fastened to the under side of a leaf or branch, sometimes three or four together, but more often only one egg is deposited in one place. After the larva hatches, it rests on its elevated perch for a while and then climbs on to the hostplant where it at once searches for small particles of debris, which it places upon its back, and "should an Aphis or young leafhopper be encountered during the search, it is seized and after being sucked dry, the empty skin is placed upon the young larva's back. . . . The larvae are most voracious feeders and besides attacking young cane-leaf-hoppers have been observed to thrust their long mandibles into the imbedded hopper-eggs and suck them." The larval period is about two weeks, and when full grown the larva is about 5 mm. long. Terry (1905:175-176) has described the mature larva as follows:

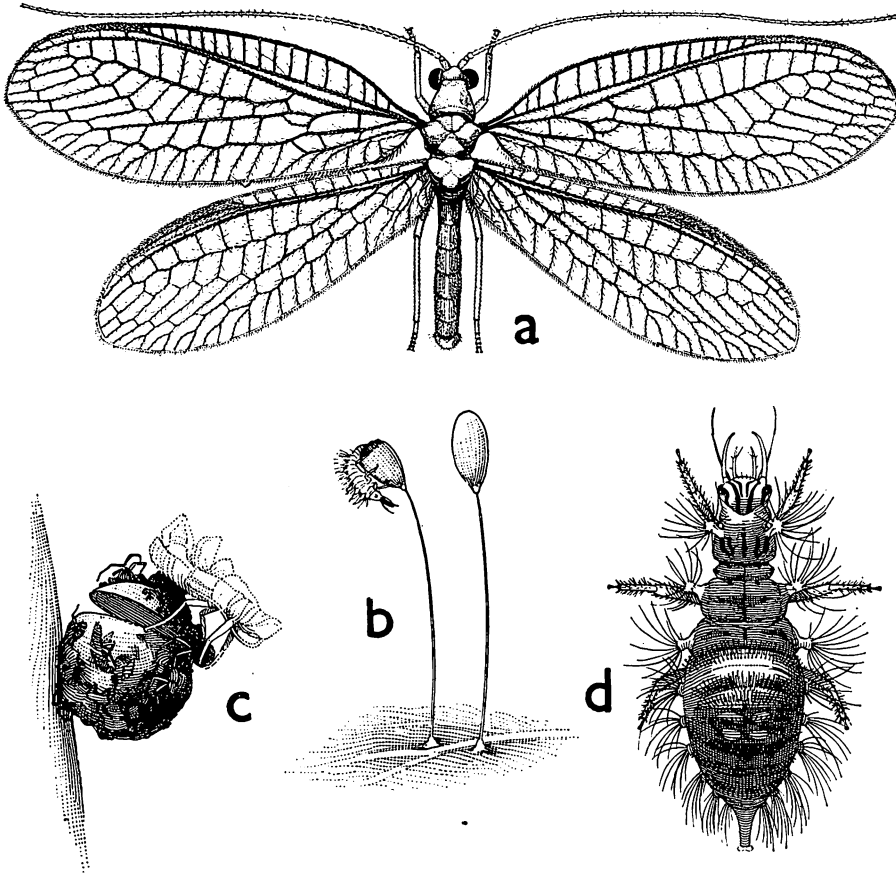


Figure 51—*Chrysopa microphya* McLachlan. a, male; b, eggs with hatching larva; c, pupal skin on cocoon; d, larva. (After Terry.)

The adult larva is about 5 mm. long. Head, across the eyes broader than long, depressed, pale greenish-testaceous, with four pairs of blackish longitudinal bands, the median pair one-third the length of the head, starting from the inner bases of the mandibles, convergent posteriorly; the extra-median pair broader, and extending from the mandibular bases to the back of the head, convergent posteriorly; the lateral pair narrow, and extending from the back of the eyes to the back of the head, the extra-lateral pair short and extending posteriorly from the sides of the eyes, this band is divided just behind the eyes, uniting shortly after. Eyes prominent, black. Mandibles, sickle-shaped, longer than the head, widely remote at their bases, testaceous, ferruginous apically.

The thoracic segments distinct from abdominal. Prothorax, broader than the head, widening anteroposteriorly, bearing anterolaterally a pair of tubercles with radiating recurved bristles. Mesothorax, much broader than prothorax, the narrow constricted portion in front appearing to belong to the former, width more than twice the length, bearing antero-laterally a pair of tubercles bearing recurved bristles. Metathorax, broader than the mesothorax. Width more than three times that of the length, bearing laterally a pair of tubercles with radiating recurved bristles. Legs moderate, whitish-testaceous.

Abdomen napiform, seven-segmented, each segment with a pair of lateral tubercles bearing bristles.

The general body coloring is pale greenish-testaceous with paired and irregular mottling of brown, the thoracic tubercles are whitish-testaceous and much larger than those of the abdomen, the latter being of the general body coloring, pale greenish-testaceous.

The ball-like, silken cocoon is about 2 mm. in diameter and is usually covered with debris. The pupal period lasts about 10 days.

This is the only lacewing in Hawaii which lays stalked eggs and the only one whose larvae cover themselves with debris.

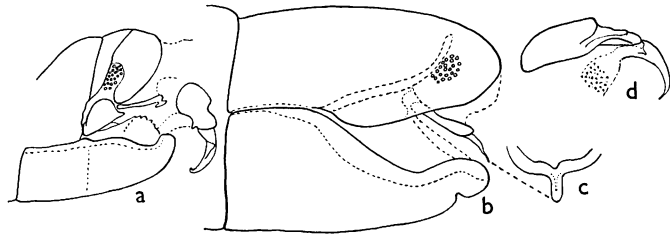


Figure 52—Male genitalia of *Chrysopa*. **a**, *microphya* McLachlan: lateral view with tenth tergite and aedeagus pulled out, example from "Kaala Mts.," Oahu, 1,500 feet; **b-d**, *lanata* Banks: **b**, lateral view; **c**, "subrectal sclerite"; **d**, lateral view of tenth sternite and aedeagus, specimen from Paia, Maui. The numerous setae are not shown.

Genus **ANOMALOCHRYSA** McLachlan, 1883:298

Perkins, 1899:47. Zimmerman, 1940:490.

The three or more series of gradate veins between the radial sector and media in the fore wings (and also in the hind wings of most species) readily serve to separate the members of this genus from *Chrysopa*.

To my knowledge, no type has been designated for *Anomalochrysa*. We may designate *Anomalochrysa hepatica* McLachlan, 1883:299, as type of the genus.

Except for occasional individuals which are now and then found below the forest belt, this group is now confined to our native forests. Most of the species are rare or very rare, and a number have not been seen since their types were collected by Perkins about 60 years ago. Parasitism by foreign parasites may have caused the evident reduction of numbers, although we know nothing of the parasites of the genus.

Although these insects are among our finest endemic products, very little is known about them. Their elongate-ovate eggs are not stalked, and they may be laid singly, or several may be laid together. The larvae, which may be brilliantly marked with red, pink, yellow, and green, do not cover themselves with debris as does *Chrysopa microphya* Banks, but they remain naked in all instars. The parchment-like, round or somewhat egg-shaped cocoons are rather hard.

Little is known of the larval habits, but some have been found to eat the nymphs of the sugarcane leafhopper, *Perkinsiella saccharicida* Kirkaldy. Some species have been seen feeding on caterpillars of native moths. Perkins (1913:clxxiii) records larvae of the geometrid genus *Scotorythra* as hosts. Terry (1905:174) found three species feeding upon immature sugarcane leafhoppers and aphids on sugarcane. Perhaps psocids also make up a large part of their food, and they probably prey extensively on the young of leafhoppers and moths. The larvae can give one a sharp bite if they drop on the bare skin, as they do on occasion, when one is collecting in the forests.

Unlike most genera of Hawaiian insects which have their major developments in the older northwest islands of Kauai and Oahu, this genus has its greatest development on the island of Hawaii, which is still in the active phase of volcanism. The distributions of the species as we know them today is as follows:

Species confined to Kauai: <i>maclachlani</i> , <i>simillima</i> , <i>viridis</i> . . . . .	2
Species confined to Oahu: <i>cognata</i> , <i>haematura</i> . . . . .	2
Species confined to Molokai: <i>angulicosta</i> , <i>molokaiensis</i> . . . . .	2
Species confined to Maui: <i>fulvescens fulvescens</i> , <i>soror</i> . . . . .	2
Species confined to Hawaii: <i>frater</i> , <i>longipennis</i> , <i>montana</i> , <i>ornatipennis</i> , <i>peles</i> , <i>princeps</i> , <i>raphidioides</i> , <i>raphidioides reticulata</i> , <i>fulvescens rhododora</i> . . . . .	9

Species found on two islands: <i>syvicola</i> (Kauai, Oahu) . . . . .	1
Species found on three islands: <i>rufescens</i> (Kauai, Oahu, Hawaii) . .	1
Species found on four islands: <i>hepatica</i> (Oahu, Molokai, Maui, Hawaii) . . . . .	1
Species found on five islands: <i>debilis</i> (Kauai, Oahu, Molokai, Lanai, Hawaii), <i>maclachlani</i> (Kauai, Oahu, Molokai, Maui, Hawaii) . . . . .	2
Species found on Kauai: <i>debilis</i> , <i>maclachlani</i> , <i>maclachlani similima</i> , <i>rufescens</i> , <i>syvicola</i> , <i>viridis</i> . . . . .	6
Species found on Oahu: <i>cognata</i> , <i>debilis</i> , <i>haematura</i> , <i>hepatica</i> , <i>maclachlani</i> , <i>rufescens</i> , <i>syvicola</i> . . . . .	7
Species found on Molokai: <i>debilis</i> , <i>angulicosta</i> , <i>molokaiensis</i> , <i>maclachlani</i> , <i>nana</i> . . . . .	5
Species found on Lanai: <i>debilis</i> . . . . .	1
Species found on Maui: <i>debilis</i> , <i>fulvescens</i> , <i>hepatica</i> , <i>soror</i> , <i>maclachlani</i> . . . . .	5
Species found on Hawaii: <i>debilis</i> , <i>frater</i> , <i>fulvescens</i> , <i>rhododora</i> , <i>hepatica</i> , <i>longipennis</i> , <i>maclachlani</i> , <i>montana</i> , <i>ornatipennis</i> , <i>peles</i> , <i>princeps</i> , <i>raphidioides</i> , <i>raphidioides reticulata</i> , <i>rufescens</i> . .	13

These distributional data reveal gaps in our knowledge of the distribution of the species and the need for more detailed collecting. I believe that more species will be found on Molokai and Maui. The single record from Lanai is most unusual and it is strange that neither Blackburn nor Perkins found any specimens on Lanai during their surveys. The endemic lacewing faunas of Niihau and Kahoolawe have evidently been exterminated because of the destruction of the native forests on those islands. Nothing is known regarding the endemic neuropterous faunas of the Leeward Islands.

*Anomalochrysa* is known only from the Hawaiian Islands, and I have no information regarding its nearest allies or whence it might have come. This fact reflects our general ignorance of the Chrysopidae as a whole.

*Anomalochrysa* is a complex of complexes. It is an extraordinarily difficult group to understand, and I have often become so confused by the problems involved that on many occasions during this survey I have almost given up the task and concluded it to be hopeless on the basis of available material and knowledge. I have spent more time per species on this genus, in an attempt to revise it, than on any other group, but I am still far from satisfied with the results now presented. The individual variation is astonishing and highly confusing. This difficulty has been compounded by the lack of adequate material and a dearth of field data. The genus is in a state of evolutionary flux, and the species are prone to be unstable and variable. Interisland transfer of populations appears to be more easily accom-

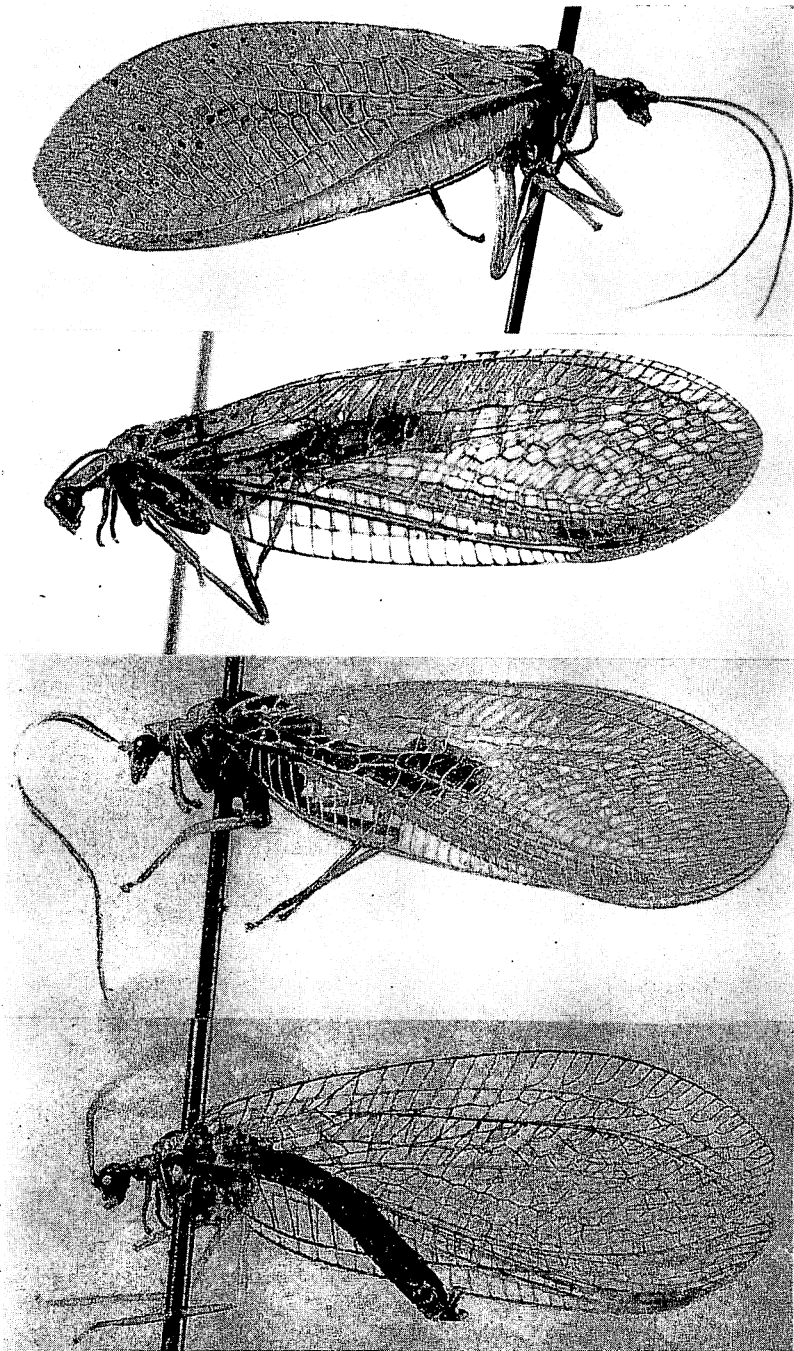


Figure 53—Lateral views of some *Anomalochrysa*. From top to bottom: *fulvescens rhododora* (Perkins), male, Kilauea Crater, Hawaii, 19.5 mm.; *raphidioides* Perkins, female, Pohakuloa, Hawaii, 18.5 mm.; *maclachlani* Blackburn, female, Kilauea Crater, Hawaii, 19 mm.; *viridis* Perkins, male, Kokee, Kauai, 15.5 mm. Not to same scale; measurements exclude antennae.

plished in this genus than in many genera of Hawaiian insects, and this fact may account for the development of variable populations and the prevention of wider divergence. The very characters which may prove useful in separating species, or even genera, in other regions become, in Hawaii, so unstable that one side of an example may have one set of characters while the other side has another. It is often difficult to find two examples which are similar. Perkins, speaking of *fulvescens* (1899:60) said, "I have examined about 50 examples of this remarkable insect. Of the examples with dark-spotted or banded wings there are no two alike, nor do the markings ever agree on the two sides of the same insect." The genitalia afford the best support for separating the species, but even the genitalia are variable and not infrequently confusing also. The preparation of analytical tables is, therefore, very difficult. It is not difficult to make keys to individuals, but to be certain that one is making keys to species is quite a different matter. I have often wondered if I were writing keys to individuals instead of species. Perkins (1899:32) said, "These species form a most interesting series, but are excessively difficult to differentiate, owing to the great variability in colour of many of them, and the instability of the characters afforded by the neurulation." Perkins did not prepare a key to the species, and the wings of only 12 of the 30 forms listed by him were illustrated. Except for rather crude drawings of the apices of the dried abdomens of four species given by Perkins, no illustrations of the genitalia or of key diagnostic features have been published. Thus, great difficulty has confronted anyone wishing to identify these insects. Perkins' examination of the male genitalia was superficial, and he did not clear or dissect his material. He stated (1899:32) that on the basis of the male genitalia "... there would appear to be two good genera, but the females of the two sections appear to present no point for generic division. . . ." I cannot support his idea that the male genitalia are so divergent, because the dissections I have made reveal a series of closely allied forms, although the male genitalia can be sorted roughly into two major sections as indicated below.

Most of the species are beautiful in life, but, unfortunately, most of the color and color patterns fade in time. The *Fauna Hawaiiensis* collection is so faded to yellow and brown that the specimens bear no relation to the beautiful creatures they once were. Many species are remarkably colored in life, but their colors and patterns are frequently subject to confusing variability.

The prothorax often appears to display usable characters of shape and structure, but such confusing variability occurs that most supposed characters are rendered worthless. Previous authors have guessed at the proportions of the prothorax, and their comments must be ignored. The size and shape is often surprisingly variable in a series of examples of one species. There are transverse impressions on the pronotum which often appear to be quite distinct and to be good specific characters, but a series of examples will reveal once again confusing variability. Some individuals will be seen whose pronota are smooth, and others have the pronotum granular. This is also a variable character. The shape of the crown of the head may appear to display specific differences, but this, too, will be found to be individually variable. The variation in wing venation must be seen to be

believed; it is amazing and highly confusing. It seems that one can never be sure that he has seen all the possible variations, even after studying a large number of specimens of the same species. The number of rows and the shapes of the gradate cells, the shape of the cubital and other cells, the courses of the veins and cross-veins, the coloring of the veins and membrane, and other characters are all variable.

Reference should be made to Perkins' original descriptions in *Fauna Hawaiiensis*, and it is intended that that work should be used in conjunction with this.

I present hereafter a general key which includes all the species, and following that key are five keys to the species known from each island. It will be noted that the same species may be placed in several different places in the key. This is because of the variability. No doubt specimens of other species will be found which will not fit the present keys, which will then have to be modified accordingly. Also, the known distributions of some of the species will be enlarged as more collecting is done, and this will require alteration of the island keys. Identifications made from the latter keys should not be accepted as positive without further checking. The measurements given in the keys apply only to specimens seen, and they do not represent the variation which may exist.

The setae or hairs on the middle of the pronotum frequently can be used to separate species, but because some species tend to blend between the groups, I could not use this feature as a prime key character. The species can be tentatively arranged on the basis of the pronotal vestiture as follows:

- I. Area along medial line of pronotum (do not confuse vestiture on sides of pronotum) with long or very long, erect or somewhat slanting, fine setae or hair, usually pale.

*angulicosta*  
*cognata*  
*debilis*  
*molokaiensis*  
*montana*  
*peles*  
*princeps*  
*sylvicola*

- II. Setae along medial area of pronotum short to very small, slanting, decurved, subprostrate or prostrate, usually not more than 1/10 mm. long, usually dark, always setaeform and not hairlike.

- A. Setae short and decurved or inclined, but not extremely small and subprostrate.

<i>frater</i>	<i>raphidioides</i>
<i>fulvescens</i>	<i>rufescens</i>
<i>haematura</i>	<i>soror</i>
<i>longipennis</i>	<i>viridis</i>
<i>ornatipennis</i>	

B. Setae very small, minute, often obscure, prostrate or subprostrate.

*hepatica*  
*maclachlani*

On the basis of the male genitalia, the following broad separations may be made:

(The males of *cognata*, *haematura*, *longipennis* and *molokaiensis* are unknown. It is probable that the male of *molokaiensis* will be similar to *sylvicola*; *cognata* may be like *angulicosta*, and *haematura* and *longipennis* may be of the *maclachlani* type.)

I. Ventral valve long and at rest normally held closed against the lateral lobes and dorso-caudal plates, the dorsal edge of which it nearly reaches, and covering much of the dorso-caudal plates, as in figure of *maclachlani*.

A. Dorso-caudal plates with large, stout spines along base.

*fulvescens*  
*raphidioides*

B. Dorso-caudal plates with only fine hair and no heavy spines.

*hepatica*  
*maclachlani*  
*rufescens*

II. Ventral valve either short or comparatively short and normally held open and not closed against the lateral lobes at rest, thus leaving the dorso-caudal plates exposed.

A. Ventro-caudal area of lateral lobes each with a cluster of long hairs or setae which are usually closely compacted and may appear in undissected specimens as a long, basally stout, finely attenuated, usually curved spine.

*debilis*  
*ornatipennis*  
*peles*  
*princeps*  
*sylvicola*

B. Ventro-caudal area of lateral lobe without a compact cluster of long hairs, but with scattered hairs or setae.

*angulicosta*  
*frater*

*montana* (only one male seen; I am not positively certain that it belongs here).

*soror*  
*viridis*

When Perkins wrote his *Fauna Hawaiiensis* monograph, he had not seen *rufescens* McLachlan, *maclachlani* Blackburn, or the unique type of *ornatipennis* Blackburn, and he described the following six species from single examples: *cognata* (Oahu), *longipennis* (Hawaii), *molokaiensis* (Molokai), *nana* (Molokai),



*paurosticta* (Hawaii) and *peles* (Hawaii). At a later date, Perkins acquired the Blackburn collection, and the types of *maclachlani* and *ornatipennis* finally came through Perkins to Bishop Museum. Additional material was assembled, and when I prepared my preliminary 1940 report I synonymized *proteus* Perkins under *hepatica* McLachlan, *deceptor* Perkins under *maclachlani* Blackburn, *rhododora* variety *xerphylla* Perkins under *rhododora* Perkins, and confirmed the synonymy of *biseriata* Perkins under *rufescens*. I then had 26 forms to treat, instead of the 30 recorded by Perkins in *Fauna Hawaiiensis*, and I prepared a set of preliminary keys which were published in the *Proceedings of the Hawaiian Entomological Society* in 1940. Unfortunately, numerous typographical errors crept into those keys which reduced their effectiveness. I have since been able to study the type collection at the British Museum, and I have remade the keys and checked the types and other material through them. With more adequate and authentic material before me, and with more time to make a careful study, I have reduced *nana* to *debilis*, *paurosticta*, *zoe* and *gayi* to *maclachlani*, with *simillima* as a subspecies, and I have reduced *reticulata* to a subspecies of *raphidioides* and *rhododora* to a subspecies of *fulvescens*. Thus, there remain 19 species and three subspecies to treat here.

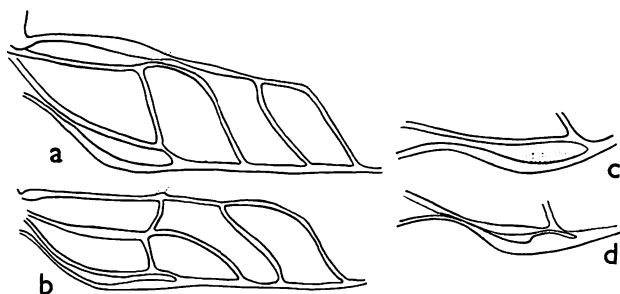


Figure 54—Some details of the base of the fore wings of *Anomalochrysa*. **a**, *maclachlani* Blackburn, showing the close approach of vein 2A to 1A; **b**, *fulvescens* Perkins, showing wide space and well developed cross-vein between 2A and 1A; **c**, *maclachlani* Blackburn, showing the open character of the cell between the posterior wing margin and vein 3A; **d**, *maclachlani simillima* (Perkins), showing the closed character of this cell. (It should be noted that the development is variable; some examples do not have the swelling of the wing margin so extreme as shown in this example.)

#### I. GENERAL KEY TO THE SPECIES OF ANOMALOCHRYSA

1. Fore wing with the cross-vein between vein 1A and 2A subequal in length to the cross-vein between 2A and 3A; vein 2A not closely approaching 1A, as in figure 54, b. . . . . 2
- Fore wing with the cross-vein between vein 1A and 2A very much shorter than that between 2A and 3A, usually very small and often greatly reduced or obsolete; vein 2A closely approaching 1A, as in figure 54, a. . . . . 3

- 2(1). Wings strongly fulvescent, especially the anterior pair, which are often mottled with variable darker spots and areas; the veins always strongly colored; Maui . . . . . type of **fulvescens fulvescens** Perkins.

Wings not strongly fulvescent; fore wings milky, opaque or sub-opaque, the cells with much coloring, whitish, brownish and maculate; veins mostly pale; Hawaii . . . . . type of **fulvescens rhododora** (Perkins).

- 3(1). Fore wing with the dividing cross-vein of the third cubital cell normally joining the distal side of cell (that is, the cross-vein between M and Cu<sub>1</sub> which forms the distal side of the cell) at a distance from its junction with M, and not joining M, so that the proximal cellule (of the divided third cell) has four sides instead of five; the third cross-vein from Cu<sub>1</sub> beyond the origin of Cu<sub>2</sub> forked; a large species, 33–45 mm. in expanse; Hawaii . . . . . type of **princeps** Perkins.

Without some or any of these characters . . . . . 4

- 4(3). Fore wing with the posterior (cubital) side of third cubital cell very long, as long or longer than the posterior (cubital) side of second cubital cell; expanse 32–39 mm.; (type of *gayi*) . . . . . some **maclachlani** Blackburn.

Fore wing with the posterior (cubital) side of third cubital cell shorter than the corresponding side of second cubital cell (although it is somewhat elongated in some species, it is never as long as above) . . . . . 5

- 5(4). Fore wing with the dividing cross-vein of the third cubital cell either joining the distal side of cell at or near M, or joining M with the distal side of the cell in a distinct swelling of M, or joining the distal side of the cell distinctly posterior (that is, toward Cu) to M (in which case the proximal part of the cell—the proximal cellule—is four-sided as in *cognata* and *princeps*), and in many examples the second cross-vein from Cu<sub>1</sub> is conspicuously swollen where it joins Cu<sub>2</sub> . . . . . 6

Fore wing with the dividing cross-vein of the third cubital cell not formed as above, but normally joining M at a distance basad of the distal side of the cell (occasionally, for example in some specimens of *longipennis* and *maclachlani*, it may join M close to

the distal side of the cell, but then there is no distinct swelling of M at that point).....7

- 6(5). Third cross-vein from  $Cu_1$  beyond the origin of  $Cu_2$  joining  $Cu_2$  far from its apex; fore wing with costal margin shallowly concave before pterostigma and cells conspicuously infusate along veins; expanse 31 mm.; Oahu.....type of **cognata** Perkins.

Third cross-vein from  $Cu_1$  joining  $Cu_2$  very close to its apex, or joining wing margin; costal margin of fore wing convex.....some **maclachlani** Blackburn.

- 7(5). Fore wings with the third cross-vein from  $Cu_1$  beyond the origin of  $Cu_2$  joining the wing margin at a distance from the apex of  $Cu_2$ ; the distance between the apex of this cross-vein and  $Cu_2$  may be nearly equal to that between its apex and the fourth cross-vein, although the separation is not always as great, the cross-vein never joining the wing margin very close to  $Cu_2$ .....8

Fore wings with the third cross-vein from  $Cu_1$  either joining  $Cu_2$  before its apex, or joining it or almost joining it at the wing margin, but never distantly separated from it at the wing margin.....13

NOTE: Because of variation, this is a weak place in the key, and some examples may lead one astray; it may be necessary to try both parts of the couplet.

- 8(7). Fore wings with the distal side of the third cubital cell conspicuously and strongly oblique and fully one-third longer than the dividing vein of the cell and joining  $Cu_1$  at the base of the fifth cross-vein from  $Cu_1$  beyond the origin of  $Cu_2$ .....9

Fore wing with the distal side of the third cubital cell only moderately oblique and at most only one-fourth longer than the dividing vein of the cell, and joining  $Cu_1$  between the fourth and fifth cross-veins from  $Cu_1$  beyond the origin of  $Cu_2$ .....11

- 9(8). Fore wing with the cell between 3A and the wing margin greatly narrowed or almost closed by a swelling of the wing margin near the branch from 2A, somewhat as in figure 54, d; expanse 42 mm.; Hawaii... type of **longipennis** Perkins.

Fore wing with the cell between 3A and the wing margin wide and not greatly narrowed near the branch from 2A by a swelling of the wing margin, although

- the wing margin may be swollen basad of the branch from 2A.....10
- 10(9). The dividing cross-vein of the third cubital cell in fore wing joining M far removed from the origin of the distal side of the cell, the distance greater than the length of the posterior proximal side of the distal cellule of the third cell; posterior side of basal cellule very heavy, the vein obviously much swollen; some faint dark spots on outer gradate cross-veins only; expanse 33–39 mm.; (type of *zoe*).....some **maclachlani** Blackburn.
- The dividing cross-vein of the third cubital cell in fore wing joining M quite close to the origin of the distal side of the cell, the distance less than the length of the posterior proximal side of the distal cellule of the third cell; posterior side of basal cellule not strongly swollen; fore wing (in type of *paurosticta*) with a dark macula across the first cross-vein between Rs and M, a similar spot across 1A anterior to the posterior margin of the wing, another similar, but less conspicuous spot on the proximal branch of the fork of the sixth cross-vein from Cu<sub>1</sub> beyond the origin of Cu<sub>2</sub>, and small dark spots on some of the gradate cross-veins; (type of *paurosticta*).....some **maclachlani** Blackburn.
- 11(8). Hairs on dorsum of abdomen of male (figure 55) coarse, dense, long, conspicuously erect and directed toward thorax, those of female shorter, but rather coarse, erect and some usually directed cephalad; first series of cells behind Rs in both pairs of wings in both sexes only moderately long and narrow as compared to those between R and Rs; expanse 29–37 mm.; Oahu, Maui, Hawaii.. (type of *proteus*) **hepatica** McLachlan.

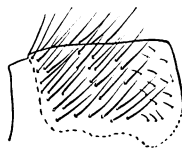


Figure 55—Lateral view of an abdominal tergite of a male *Anomalochrysa hepatica* McLachlan, showing the erect, slanting hairs directed toward the head (to the right).

Hairs on dorsum of abdomen of both sexes fine, not very long, usually comparatively sparse, mostly directed caudad; first series of cells behind Rs in both wings of both sexes conspicuously long and narrow as compared to the cells between R and Rs, usually three or four times as high as wide. . . . .12

- 12(11). Fore wings with the cell formed between 3A and the wing margin entirely open throughout its length, the wing margin not so thickened near to where the branch of 2A joins 3A as to close the cell. . . . .  
 . . . . .(type of *deceptor*) **maclachlani** Blackburn.

Fore wing with the cell between 3A and the wing margin not entirely open, but closed or almost closed by the arcuation of the hind margin at just before half the length of 3A from its base and again at a distinct swelling of the margin just before the point where the branch of 2A joins 3A; wings as illustrated, somewhat narrower than in typical *maclachlani* because the first row of gradate cells are proportionately not so long and narrow as compared to the cells between R and Rs; Kauai only. . . . .  
 . . . . .type of **maclachlani simillima** Perkins.

- 13(7). Fore wing with at most only three rows of gradate cells between Rs and M. . . . .14

Fore wing with four or five rows of gradate cells in some places between Rs and M. . . . .23

- 14(13). Hind wing with only two rows of gradate cells between Rs and M distad. . . . .15

Hind wing with three or four rows of gradate cells between Rs and M distad. . . . .17

- 15(14). Medial line of pronotum with long, fine, erect hairs or slanting setae of moderate length. . . . .15a

Medial line of pronotum with short, decurved or depressed setae or rather thorn-like setae or wing veins thick and heavy. . . . .16

- 15a(15). Medial line of pronotum with long, fine, erect, pale hair. . . . .some **debilis** Perkins.

Medial line of pronotum with rather short, slanting setae. . . . .some **ornatipennis** Blackburn.

- 16(15). Posterior series of cells between Rs and M in fore wings consisting of only four or five cells; gradate nervures extending the line of M in fore wings assuming a conspicuous zigzag course beyond first two or three basal cells of posterior series of gradate cells; abdominal hairs, especially below, long, shaggy and conspicuous; setae in middle of pronotum slanting; body often with considerable red coloration; male not seen; expanse 27–32 mm.; Oahu.....  
 .....some **haematura** Perkins.
- Posterior series of cells between Rs and M in fore wing consisting of more than five cells; the gradate nervures extending the line of M in fore wing only moderately zigzag and not assuming a strongly zigzag course after first few cells of posterior series of gradate cells; setae on middle of pronotum very short and subprostrate; abdominal hairs short; body usually yellowish or brownish and without conspicuous reddish coloration; costal margin of fore wings of male conspicuously lobed beyond middle; expanse 24–27 mm.....type of **rufescens** McLachlan.
- 17(14). Fore wing with the third cross-vein from Cu<sub>1</sub> beyond the origin of Cu<sub>2</sub> joining wing margin close to Cu<sub>2</sub> but not joining Cu<sub>2</sub> distinctly before its apex; fore wing normally suffused with brown in mature females and veins very bold (Note: rarely an abnormal specimen of *viridis* from Kauai will run to here, but it may be distinguished by its small size and paler, green color); expanse 31–37 mm.; Hawaii.....  
 .....some **raphidioides raphidioides** Perkins.
- Fore wing with third cross-vein from Cu<sub>1</sub> obviously joining Cu<sub>2</sub> at a distance from the wing margin.....18
- 18(17). Costa of fore wing modified, either expanded or sinuous before pterostigma; fore-wing membrane whitish and/or with all cells distinctly infuscate along veins..19
- Costa of fore wing normal, convex; fore-wing membrane entirely hyaline, not whitish, not infuscated along veins, or at most faintly infuscated along some gradate cross-veins.....20

- 19(18). Fore wing with dividing cross-vein of third cubital cell either joining M at or near distal side of cell so that the distance between the dividing cross-vein and the distal side of cell is obviously much shorter than length of dividing cross-vein, or joining distal side of cell instead of joining M so that the proximal cellule is four-sided; distal branch of vein 2A nearly straight beyond its basal arcuation, as in figure 56; male unknown; expanse 29–31 mm.; Oahu.....  
.....atypical **cognata** Perkins.

Fore wing with dividing cross-vein of third cubital cell joining M at a distance from distal side of cell so that distance between cross-vein and distal side of cell is about equal to length of dividing cross-vein; costal margin of male conspicuously and unusually expanded and angulate about at eleventh or twelfth propterostigmatic cross-vein; distal branch of vein 2A strongly arcuate and decurved distad, as in figure 56; expanse 32–34 mm.; Molokai.....  
.....type of **angulicosta** Perkins.

- 20(18). Fore wing with 19–22 propterostigmatic cells between C and Sc; Hawaii....type of **ornatipennis** Blackburn.

Fore wing usually with about 25 or more propterostigmatic cells between C and Sc.....21

- 21(20). Hair on abdomen rather coarse and stiff, mostly dark, long; body with considerable red coloration; expanse 27–32 mm.; Oahu.....type of **haematura** Perkins.

Hair on abdomen short and comparatively sparse or moderately long and fine, usually pale, never coarse and stiff.....22

- 22(21). Kauai species; head, pronotum and mesonotum marked with brown and black; vein 1A in hind wing not forked; ventral lobe of male genitalia projecting well beyond lateral valves; expanse 28–32 mm.....  
.....some **viridis** Perkins.

Hawaii species; head, pronotum and mesonotum marked with extensive pink or red; vein 1A in hind wing forked; ventral lobe of male genitalia short and not projecting much beyond lateral valves; expanse 22–26 mm.....**montana** Blackburn.

- 23(13). Fore wing with third cross-vein from  $Cu_1$  beyond origin of  $Cu_2$  joining wing margin close to apex of  $Cu_2$ , but not joining  $Cu_2$  . . . . . 24  
 Fore wing with third cross-vein from  $Cu_1$  beyond origin of  $Cu_2$  obviously joining  $Cu_2$  before its apex . . . 28
- 24(23). Dividing cross-vein of third cubital cell in fore wing joining M near origin of distal side of cell, separated from distal side of cell by less than, or hardly more than length of posterior, proximal side of cell, distal side of cell strongly oblique . . . . .  
 . . . . . some **maclachlani** Blackburn.  
 Dividing cross-vein of third cubital cell widely separated from origin of distal side of cell, the length of separation greater than length of posterior proximal side of cell . . . . . 25
- 25(24). Distance between Cu and wing margin in hind wing usually little greater than distance between Cu and M, always less than twice as great, the cells thus not very elongate; Kauai . . . . . some **viridis** Perkins.  
 Distance between Cu and wing margin in hind wing more than twice as great as between Cu and M, the cells thus very elongate . . . . . 26
- 26(25). Base of fore wing with cell between 3A and wing margin closed, or nearly closed by wing margin curving inward to touch or nearly touch 3A, and with a distinct swelling before apex of cell; dorsal abdominal hair of male long, coarse, erect, mostly directed cephalad, that of female shorter but erect and usually with some directed cephalad . . . . .  
 . . . . . some **hepatica** McLachlan.  
 Base of fore wing with cell between 3A and wing margin open from base to apex; dorsal abdominal hair in both sexes fine and mostly slanting caudad . . . . . 27
- 27(26). Fore wings with membrane along veins moderately to strongly infusate; pterostigma in both pairs of wings very dark in female (unusually dark), not unusually dark in male . . . . .  
 . . . . . type of **raphidioides raphidioides** Perkins.  
 Fore wings without infuscation along veins; pterostigma in female (only sex known) pale to moderately embrowned . . . . .  
 . . . . . type of **raphidioides reticulata** (Perkins).



- 28(23). Hind wing with four series of gradate cells at least in some places between Rs and M . . . . . 29  
 Hind wing with at most three series of gradate cells between Rs and M . . . . . 33
- 29(23). Fore wing with most cells conspicuously infusate along veins; expanse 32 mm.; Hawaii . . . . . type of **peles** Perkins.  
 Fore wing not infusate along the veins, at most with only a few faint infuscations, or gradate cross-veins only may be darkened . . . . . 30
- 30(29). Fore wing with about 30 to 40 propterostigmatic cells between C and Sc; expanse 35 to over 40 mm.; middle of disc of pronotum with long, erect, pale hair . . . . . 31  
 Fore wing usually with not more than 25 propterostigmatic cells between C and Sc; expanse 26–32 mm.; middle of disc of pronotum with short, inclined or decurved setae . . . . . 32
- 31(30). Expanse 35–40 mm.; fore wings with 25–35 propterostigmatic cells between C and Sc; Kauai, Oahu . . . . . type of **sylvicola** Perkins.  
 Expanse about 43 mm. in only known specimen; fore wing with 39 or 40 propterostigmatic cells between C and Sc; Molokai . . . type of **molokaiensis** Perkins.
- 32(30). Dorsal abdominal hair of male coarse, dark, erect or directed cephalad; female with screw-like appendage to spermatheca; Hawaii . . . . . some **frater** Perkins.  
 Dorsal abdominal hair of male fine, mostly pale, directed caudad; female without a screw-like appendage to spermatheca; Kauai . . . . . some **viridis** Perkins.
- 33(28). Fore wing with cells faintly or strongly infusate along gradate cross-veins and/or gradate cross-veins and usually some others darkened . . . . . 34  
 Fore wing without infuscation along gradate cross-veins and cells entirely hyaline . . . . . 37
- 34(33). Middle of disc of pronotum with dark slanting setae . . . 34a  
 Middle of disc of pronotum with long, erect, fine, pale hair or moderately slanting, pale hair . . . . . 35
- 34a(34). Male with abdominal tergites with long, coarse, erect anteriorly directed dark setae; female with a screw-like appendage on spermatheca . . type of **frater** Perkins.

- Male with vestiture of abdominal ventrites not as above, directed caudad; female unknown . . . . .  
 . . . . .some **ornatipennis** Blackburn.
- 35(34). Costa in fore wings obviously convex and arcuate to about middle, thence shallowly concave before pterostigma, as illustrated; cells strongly infuscated; Oahu . . . . .some **cognata** Perkins.
- Costa in fore wing after basal arcuation running in a nearly straight and flattened contour to pterostigma, as illustrated; infuscations delicate . . . . .36
- 36(35). Fore wing with not over 25 propterostigmatic cells between C and Sc in types, but number may be variable (type of *nana*) . . . . .type of **debilis** Perkins.
- Fore wing with more than 30 propterostigmatic cells . . . . .  
 . . . . .some **sylicola** Perkins.
- 37(33). Abdominal tergites of male with coarse, erect or anteriorly inclined, usually dark hair; apices of wings of both sexes apically angulate; expanse 26–32 mm.; Hawaii . . . . .some **frater** Perkins.
- Abdominal tergites of male with fine, posteriorly directed hairs; apices of wings of both sexes pointed or rounded . . . . .38
- 38(37). Fore wings more rounded than angulate at their apices, not distinctly angulate in any case; expanse 25–28 mm.; Maui . . . . .type of **soror** Perkins.
- Fore wings distinctly angulate at their apices . . . . .39
- 39(38). Middle of disc of pronotum with long, erect, pale hairs . . . . .some **debilis** Perkins.
- Middle of disc of pronotum with short, decurved or inclined setae . . . . .40
- 40(39). Kauai species, as in figure 89 . . . . .type of **viridis** Perkins.
- Hawaii species . . . . .41
- 41(40). Female **frater** Perkins and **ornatipennis** Blackburn; see the text for discussion.

## II. KEY TO THE ANOMALOCHRYSA OF KAUAI

1. Hind wing with only two rows of gradate cells between Rs and M; costa of fore wing of male lobed beyond middle and veins heavy . . . . . **rufescens** McLachlan.  
Hind wing with three or more rows of gradate cells between Rs and M; costa of male fore wing normal, not lobed . . . . . 2
- 2(1). Median line of pronotum with long, fine, erect, pale hairs . . . . . 3  
Median line of pronotum with short inclined setae or very short, prostrate or subprostrate setae . . . . . 4
- 3(2). Fore wing with 16 or fewer cells between R and Rs; male with dorsal apical tongue-like process of ventral genital plate long and slender . . . . . **debilis** Perkins.  
Fore wing with 19 or more cells between R and Rs; male with dorsal apical tongue-like process of ventral plate of genitalia broad . . . . . **sylvicola** Perkins.
- 4(2). Fore wing with third cross-vein from Cu<sub>1</sub> beyond origin of Cu<sub>2</sub> usually joining Cu<sub>2</sub> much before its apex; cells behind Rs in fore wing not much different from those between R and Rs; hind wing with distance between Cu and posterior wing margin only little greater than distance between Cu and M . . . . .  
. . . . . **viridis** Perkins.  
Fore wing with third cross-vein from Cu<sub>1</sub> beyond origin of Cu<sub>2</sub> joining wing margin and not Cu<sub>2</sub>; cells behind Rs in fore wing narrow, elongate; in hind wing distance between Cu and posterior wing margin obviously much longer than space between M and Cu (at least twice as great), the cells behind Cu thus long and narrow . . . . . 5
- 5(4). Fore wing with cell between 3A and wing margin open, as in figure 54, c. . . . .  
. . . . . **maclachlani maclachlani** Blackburn.  
Fore wing with cell between 3A and wing margin closed, as in figure 54, d. . . . .  
. . . . . **maclachlani simillima** (Perkins).

## III. KEY TO THE ANOMALOCHRYSA OF OAHU

1. Hind wing with at most two series of gradate cells between Rs and M distad . . . . . 2  
Hind wing with at least three series of cells between Rs and M distad . . . . . 3
- 2(1). Posterior series of cells between Rs and M in fore wing consisting of only four or five cells; gradate nervures extending the line of M assuming a conspicuously zigzag course beyond first two or three basal cells of the posterior series of cells between Rs and M; abdominal hairs, especially below, long and conspicuous; body often with considerable red coloration . . . . . **haematura** Perkins.  
Posterior series of cells between Rs and M in fore wing consisting of more than five cells; gradate nervures extending the line of M in fore wing not assuming a strongly zigzag course after the first few basal cells of the posterior series of cells between Rs and M; body usually yellowish or brownish and without conspicuous reddish coloration; costal margin of fore wing of male conspicuously lobed beyond middle . . . . . **rufescens** McLachlan.
- 3(1). Fore wing with all cells infusate along veins; dividing cross-vein of third cubital cell usually joining M at or near to distal side of the cell or joining distal side of cell so that distal cellule often has only four sides; costa shallowly concave before pterostigma in fore wings . . . . . **cognata** Perkins.  
Fore wing without distinct infuscations along veins, at most faintly infusate along some of gradate cross-veins only; distal cellule of third cubital cell always with five sides; costa not concave before pterostigma in fore wings . . . . . 4
- 4(3). Fore wing with third cross-vein from posterior side of Cu<sub>1</sub> beyond origin of Cu<sub>2</sub> not reaching wing margin, but joining Cu<sub>2</sub> before its apex . . . . . 5  
Fore wing with third cross-vein from Cu<sub>1</sub> reaching wing margin and not joining Cu<sub>2</sub> . . . . . 7
- 5(4). Fore wings with only three rows of gradate cells, veins heavy (especially R), usually dark; abdominal hair

- rather coarse and stiff; median line of pronotum with short setae . . . . . **haematura** Perkins.
- Fore wings with four series of gradate cells, veins not dark and bold; median line of pronotum with long, erect, fine, pale hair . . . . . 6
- 6(5). Fore wing with 16 or fewer cells between R and Rs; male with dorsal apical tongue-like process of ventral plate of genitalia long and slender . . **debilis** Perkins.
- Fore wing with 19 or more cells between R and Rs; male with dorsal, apical tongue-like process of ventral plate of genitalia broad . . . . . **sylvicola** Perkins.
- 7(4). Hairs on abdominal tergites of male (figure 55) coarse, dense, long, conspicuously erect, directed cephalad, usually dark; first series of cells behind Rs in both pairs of wings not unusually high and narrow . . . . . **hepatica** McLachlan.
- Hairs on abdominal tergites of male fine, pale, mostly directed caudad; first series of cells behind Rs in both pairs of wings of both sexes conspicuously high and narrow as compared to those between Rs and R . . . . . **maclachlani** Blackburn.

## IV. KEY TO THE ANOMALOCHRYSA OF MOLOKAI

1. Median line of pronotum with short or very short setae . . 2
- Median line of pronotum with long, erect, fine, pale hair . . . . . 3
- 2(1). Hind wing with first series of cells behind Rs high and narrow, obviously much higher and narrower than those between R and Rs, often four times as high as wide; hairs on abdominal tergites of male fine, pale, mostly directed caudad . . **maclachlani** Blackburn.
- Hind wing with first series of cells behind Rs not conspicuously high and narrow, but rather similar in shape to those between R and Rs, although mostly higher than those cells, but not usually more than twice as high as wide and never approaching four times as high as wide; hair on abdominal segments of male dense, coarse, long, conspicuously erect, directed cephalad, usually dark (figure 55) . . . . . **hepatica** McLachlan.

- 3(1). Fore wing with 16 or fewer cells between R and Rs, and fewer than 25 propterostigmatic cells between C and Sc; expanse usually less than 27 mm. . . . . **debilis** Perkins.  
 Fore wing with more than 16 cells between R and Rs, and more than 25 propterostigmatic cells; expanse over 30 mm. . . . . 4
- 4(3). Costal margin of fore wing of male expanded, conspicuously and unusually angulate in the region of the tenth to twelfth propterostigmatic cross-veins from base; all cells in fore wing infusate. . . . . **angulicosta** Perkins.  
 Costal margin of fore wing of male normal, not angulate; fore wings at most infusate only along a few gradate cross-veins. . . . . **molokaiensis** Perkins.

#### V. KEY TO THE ANOMALOCHRYSA OF MAUI

1. Fore wing with the cross-vein between vein 1A and 2A subequal in length to the cross-vein between 2A and 3A; vein 2A not closely approaching 1A, as in figure 54, b. . . . . **fulvescens** Perkins.  
 Fore wing with the cross-vein between 1A and 2A very much shorter than that between 2A and 3A, usually very small and often greatly reduced or obsolete; vein 2A closely approaching 1A, as in figure 54, a. . . . . 2
- 2(1). Fore wing with the third cross-vein given off from posterior side of Cu<sub>1</sub> beyond origin of Cu<sub>2</sub> joining Cu<sub>2</sub>. . . 3  
 Fore wing with the third cross-vein from Cu<sub>1</sub> beyond origin of Cu<sub>2</sub> reaching the wing margin and not joining Cu<sub>2</sub>. . . . . 4
- 3(2). Median line of pronotum with long, erect, fine, pale hair; fore wings with the cells faintly infusate along the gradate veins; wing tips angulate. . . . **debilis** Perkins.  
 Median line of pronotum with short setae; fore wings without infuscation along gradate veins, cells entirely hyaline; wing tips rounded. . . . . **soror** Perkins.
- 4(2). Hind wing with first series of cells behind Rs high and narrow, obviously much higher and narrower than those between R and Rs, often four times as high as wide; hairs on abdominal tergites of male fine, pale, mostly directed caudad. . . . . **maclachlani** Blackburn.

Hind wing with first series of cells behind Rs not conspicuously high and narrow, but rather similar in shape to those between R and Rs, although mostly higher than those cells, but usually not more than twice as high as wide, never approaching four times as high as wide; hair on abdominal tergites of male coarse, dense, long, conspicuously erect, directed cephalad, usually dark. . . . . **hepatica** McLachlan.

# VI. KEY TO THE ANOMALOCHRYSA OF HAWAII

1. Fore wing with the cross-vein between vein 1A and 2A subequal in length to the cross-vein between 2A and 3A; vein 2A not closely approaching 1A; as in figure 54, b. . . . . **fulvescens rhododora** (Perkins).

Fore wing with the cross-vein between 1A and 2A very much shorter than that between 2A and 3A, usually very small and often greatly reduced or obsolete; vein 2A closely approaching 1A, as in figure 54, a. . . . . 2

- 2(1). Median line of pronotum with long, fine, erect, usually pale hairs. . . . . 3

Median line of pronotum with short, slanting setae, or very short, decurved, subprostrate or prostrate, usually dark setae. . . . . 6

- 3(2). Fore wing with the dividing cross-vein of third cubital cell normally joining distal side of cell (that is, the cross-vein between M and Cu<sub>1</sub> which forms distal side of cell) at a distance from its junction with M, and not joining M in normal manner, so that the proximal cellule (of the divided third cell) has four sides instead of the usual five; third cross-vein from Cu<sub>1</sub> beyond origin of Cu<sub>2</sub> forked; a large species, 33–45 mm. . . . . **princeps** Perkins.

Without such a combination of characters. . . . . 4

- 4(3). Hind wing with four series, and fore wing with five or more series of gradate cells in some places between Rs and M. . . . . **peles** Perkins.

Hind wing with not more than three series and fore wing with mostly three, but sometimes with four series of gradate cells in some places between Rs and M. . . . . 5

- 5(4). Head suffused with red; pronotum with a prominent red median stripe; vein 1A in hind wing forked in examples seen . . . . . **montana** Blackburn.  
 Dorsum with a yellow stripe; vein 1A in hind wing simple in examples seen . . . . . **debilis** Perkins.
- 6(2). Hind wing with only two rows of gradate cells between Rs and M, and vein 1A forked at a distance from its apex; fore wing of male with costa conspicuously lobed before pterostigma; wings as in figure 84 . . . . . **rufescens** McLachlan.  
 Without such a combination of characters; hind wing usually with three series of gradate cells . . . . . 7
- 7(6). Fore wing with the third cross-vein from Cu<sub>1</sub> beyond the origin of Cu<sub>2</sub> joining Cu<sub>2</sub> usually well before its apex . . . . . 8  
 Fore wing with the third cross-vein from Cu<sub>1</sub> beyond the origin of Cu<sub>2</sub> joining wing margin . . . . . 9
- 8(7). Male with abdominal tergites with long, coarse, erect, anteriorly directed dark setae; female with an unusual screw-like appendage on spermatheca (figure 92, b) . . . . . **frater** Perkins.  
 Male with vestiture of dorsum of abdomen normal, the hairs fine and directed caudad; female spermatheca unknown . . . . . **ornatipennis** Blackburn.
- 9(7). Fore wing with the cell between 3A and wing margin closed or nearly closed by a swelling of the wing margin near the apex of the cell . . . . . 10  
 Fore wing with the cell between 3A and the wing margin open to apex . . . . . 11
- 10(9). Abdominal tergites of male (figure 55) with long, coarse, conspicuously erect setae directed toward thorax, the setae of the female shorter, but rather coarse, and some directed toward thorax; fore wing with distal side of third cubital cell nearly vertical . . . . . **hepatica** McLachlan.  
 Abdominal tergites of both sexes with fine hair which is mostly directed caudad; fore wing with distal side of third cubital cell strongly oblique . . . . . **longipennis** Perkins.
- 11(9). The row of cells behind Rs in both pairs of wings very long and narrow, as much as four or more times as long as broad, those in hind wing as much as twice



as long as cells between R and Rs; fore wings with more than 15 cells behind Rs from the point where the gradate cross-veins begin to the apex.....  
.....**maclachlani** Blackburn.

These cells not very long and narrow; although the cells in the row behind Rs in both wings are somewhat longer than those between R and Rs, they are shaped somewhat like those cells, and there are less than 15 cells behind Rs in fore wing from the point where the first row of gradate cross-veins begins and the wing margin.....12

- 12(11). Fore wings with membrane along veins moderately to strongly infusate; pterostigma in both pairs of wings very dark in female (unusually dark), not unusually dark in male.....**raphidioides raphidioides** Perkins.

Fore wings without infuscation along veins; pterostigma in female (only sex known) pale to moderately embrowned.....**raphidioides reticulata** (Perkins).

**Anomalochrysa angulicosta** Perkins (figs. 56; 57).

*Anomalochrysa angulicosta* Perkins, 1899:50, pl. 3, fig. 3.

Endemic. Molokai (type locality: 4,000 to 5,000 feet); I have determined material taken near the rim of Waikolu Valley.

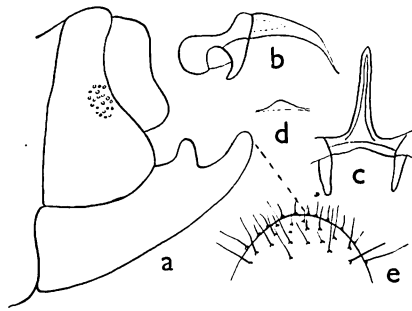


Figure 56—Male genitalia of *Anomalochrysa angulicosta* Perkins, holotype. **a**, lateral view, setae omitted (In this and other similar illustrations, the left dorso-caudal plate, behind the trichobothria, is pulled out into view, but its shape in the drawings should not be accepted as accurate or as a character difference; its vestiture is, however, of use in identification, and on this species it is clothed with fine hair.); **b**, **c**, lateral and dorsal views of tenth sternite and aedeagus (Do not rely on the shape of the tenth sternite as a good character; it is variable, partly because of distortion, but its general form and relative size are valuable. The degree of sclerotization, often shown by dotted lines, appears individually variable. Not all setae are shown in the figures. It must be borne in mind that these sketches are diagrams made from specimens treated in KOH and should be interpreted in that light.); **d**, median sclerotization of "subrectal sclerite" (a sclerotization in the ventral membrane of the rectum); **e**, ventro-caudal view of apex of ninth sternite.

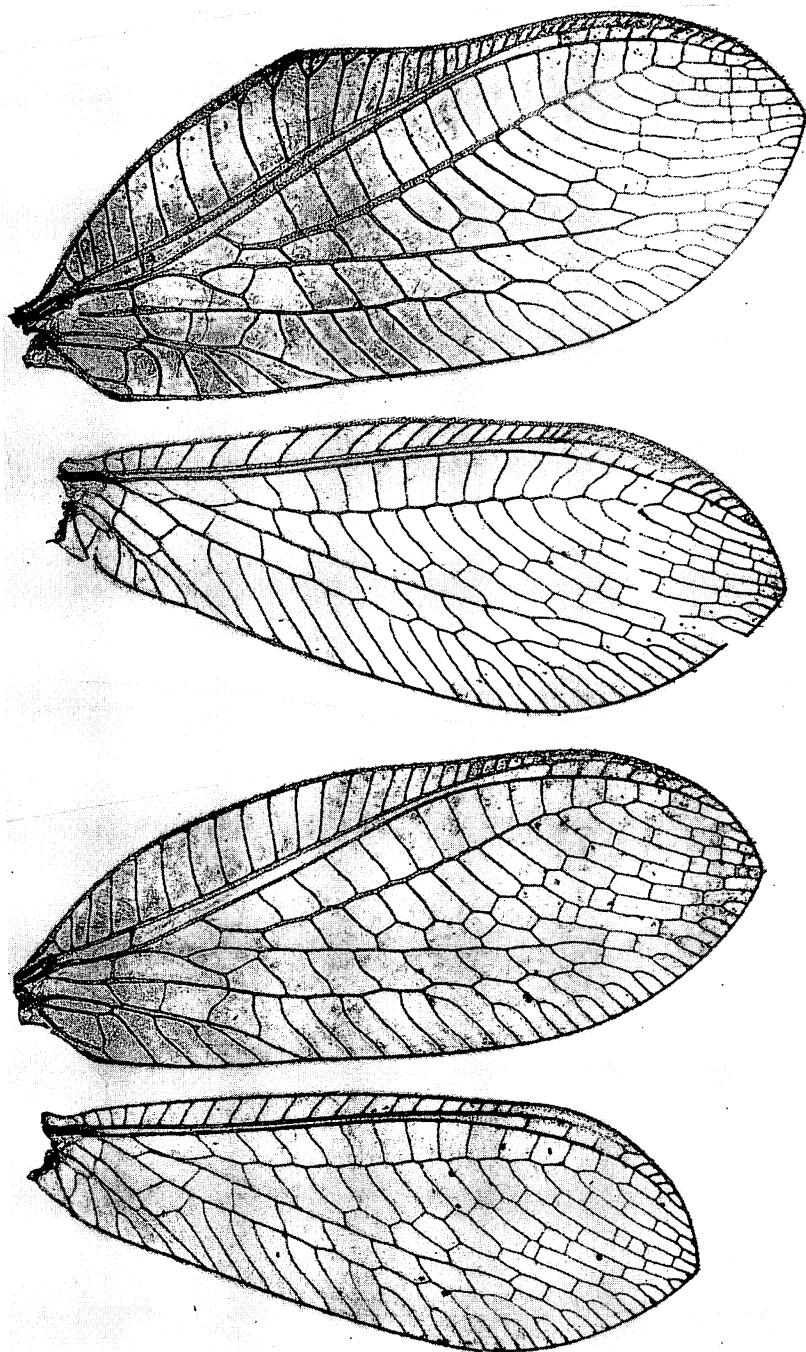


Figure 57—Above: Wings of *Anomalochrysa angulicosta* Perkins, holotype male; Molokai mountains; fore wing length, 15 mm. Below: *cognata* Perkins, holotype female; Honolulu; fore wing length, 14 mm.

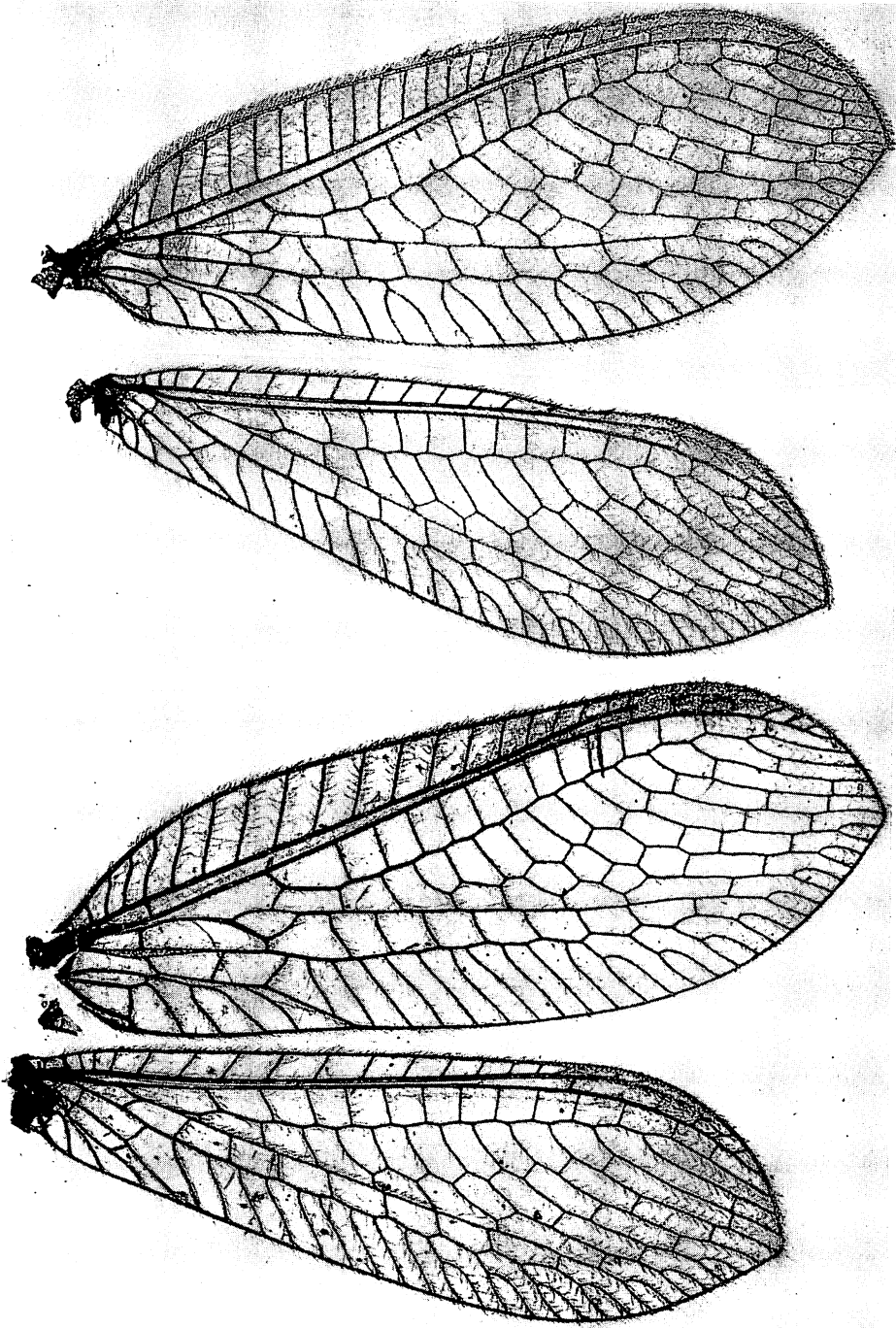


Figure 58—Above: Wings of *Anomalochrysa debilis* Perkins, male holotype; Koolau Range, Oahu; fore wing length, 11.5 mm. Below: The female holotype of *nana* Perkins; Molokai, 3,000 feet; fore wing length, 10.5 mm.; here considered a synonym of *debilis*.

Although Perkins stated that he described this species from a male and a female, only the male holotype is in the British Museum, and I have not seen a female at this writing.

This is a fine species whose male has the unusual angulation of the costa of the fore wing which accounts for its name. The costal area in the male is broadened to near the middle, thence rapidly narrowed to give the angulate appearance that is characteristic. The male of *Anomalochrysa rufescens* has the costa of the fore wing lobed *beyond* the middle, and it has only two series of gradate cells in the hind wing instead of three as in *angulicosta*. These two species are not closely allied, and the lobing of the fore wings in the male has arisen independently in the two species.

See the notes under *cognata* below for further information.

***Anomalochrysa cognata*** Perkins (figs. 57; 92, a, a'; 94, c).

*Anomalochrysa cognata* Perkins, 1899:50. Zimmerman, 1940:491.

Endemic. Oahu (type locality: "Mountains near Honolulu," 3,000 feet). I have seen examples from Mount Tantalus, Kealakei and Palolo.

Perkins described this form from one female. At this writing, I have before me four additional females and on previous occasions I have seen other females; but I have not seen a male. These females seem so close to *angulicosta* that it appears that they may represent the female of that species. The slight concavity in the costa of the fore wing before the pterostigma would appear to indicate that the male would have the costal angulation as is found in *angulicosta*. In the holotype of *cognata*, the dividing cross-vein of the third cubital cell joins the distal side of the cell below M; the distal cellule therefore has only four sides instead of the normal five. The same condition is found in another female. In another specimen the dividing cross-vein joins the distal side of the cell at M in the right wing, but it joins M very near where the distal side of the cell joins M in the left wing, and a similar condition exists in both right and left wings of another example. In the fifth female now at hand, the dividing cross-vein joins M distinctly basad of the point where the distal side of the cell joins M, and the distance between the apex of the dividing cross-vein and the point where the distal side of the cell joins M is as long as the posterior basal side of the cell. (This example was labeled by Perkins "cognata var, neuration!!!!") In the holotype of *angulicosta* there are three series of gradate cells in the main gradate field (with a further division to four series subapically only) in the fore wings, but in all examples of *cognata* before me there are one or more places in the main gradate field in each wing where there are four series, and the character is quite variable. In the holotype of *angulicosta*, vein 2A in the fore wing has its distal branch strongly arcuate and apically recurved basad, but in all specimens of *cognata* seen this vein straightens out after its basal arcuation and runs nearly straight to the wing margin. Both forms are conspicuously infusate along the veins and cross-veins in the fore wings.

With the limited material at hand, I am unable to solve the problem of the relationships between *angulicosta* and *cognata*.

**Anomalochrysa debilis** Perkins (figs. 58; 59; 93, b, b'; 95, b).

*Anomalochrysa debilis* Perkins, 1899:49. Zimmerman, 1940:491.

*Anomalochrysa nana* Perkins, 1899:52. **New synonym.**

Endemic. Kauai, Oahu (type locality of *debilis*: Koolau Range), Molokai (type locality of *nana*: 3,000 feet), Maui, Lanai, Hawaii.

A serious discrepancy is evident between the data on the male holotype in the British Museum and the locality printed in *Fauna Hawaiiensis*, where it is stated to be at about 3,000 feet elevation at Kona, Hawaii. The holotype is labeled as having been collected on Oahu, as noted above; the male paratype, however, is labeled Kona.

The Kauai record is new and is based upon material taken by D. E. Hardy in Halemanu Swamp, August, 1943. The Molokai record is new and is based upon material collected by E. Dresner at Wailau Valley, July, 1952. The Lanai record is new and is based upon a specimen from the W. M. Giffard collection taken at 2,000 feet, December 14, 1916.

In life, this species may have a bright yellow dorsal stripe from head to apex of the abdomen. The wings may be quite milky and the infuscations may be very distinct, or the characters may be hardly evident. The gradate cross-veins in the hind wing may be lost to such a degree that there may be only one or two rows of cells present in the gradate field, whereas there are three rows of these cells in the holotype. This species, *montana* and *peles* appear closely allied.

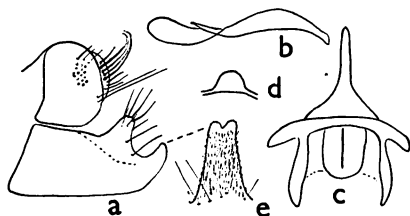


Figure 59—Male genitalia of the holotype of *Anomalochrysa debilis* Perkins. **a**, lateral view; **b**, **c**, lateral and dorsal views of tenth sternite and aedeagus; **d**, median sclerotization of subrectal sclerite; **e**, caudal view of apex of ninth sternite.

**Anomalochrysa frater** Perkins (figs. 60; 61; 92, b; 94, b).

*Anomalochrysa frater* Perkins, 1899:52, pl. 4, fig. 18. Zimmerman, 1940:491.

Endemic. Hawaii (type locality: Kona, 2,000 to 4,000 feet).

The males of this species are easily recognized by the long, bristling erect setae (which are mostly directed basad) on the abdominal tergites. The females, however, often cause difficulty in determination. The peculiar type of vestiture on the male abdomen is shared only with male *hepatica*, and the character has been evolved independently in the two species. The spermatheca of the female is the most unusual of all *Anomalochrysa*, as the illustration clearly demonstrates. It has a remarkable, long, screw-like appendage, and no other *Anomalochrysa* known to me has any suggestion of such a structure. It so surprised me to discover such

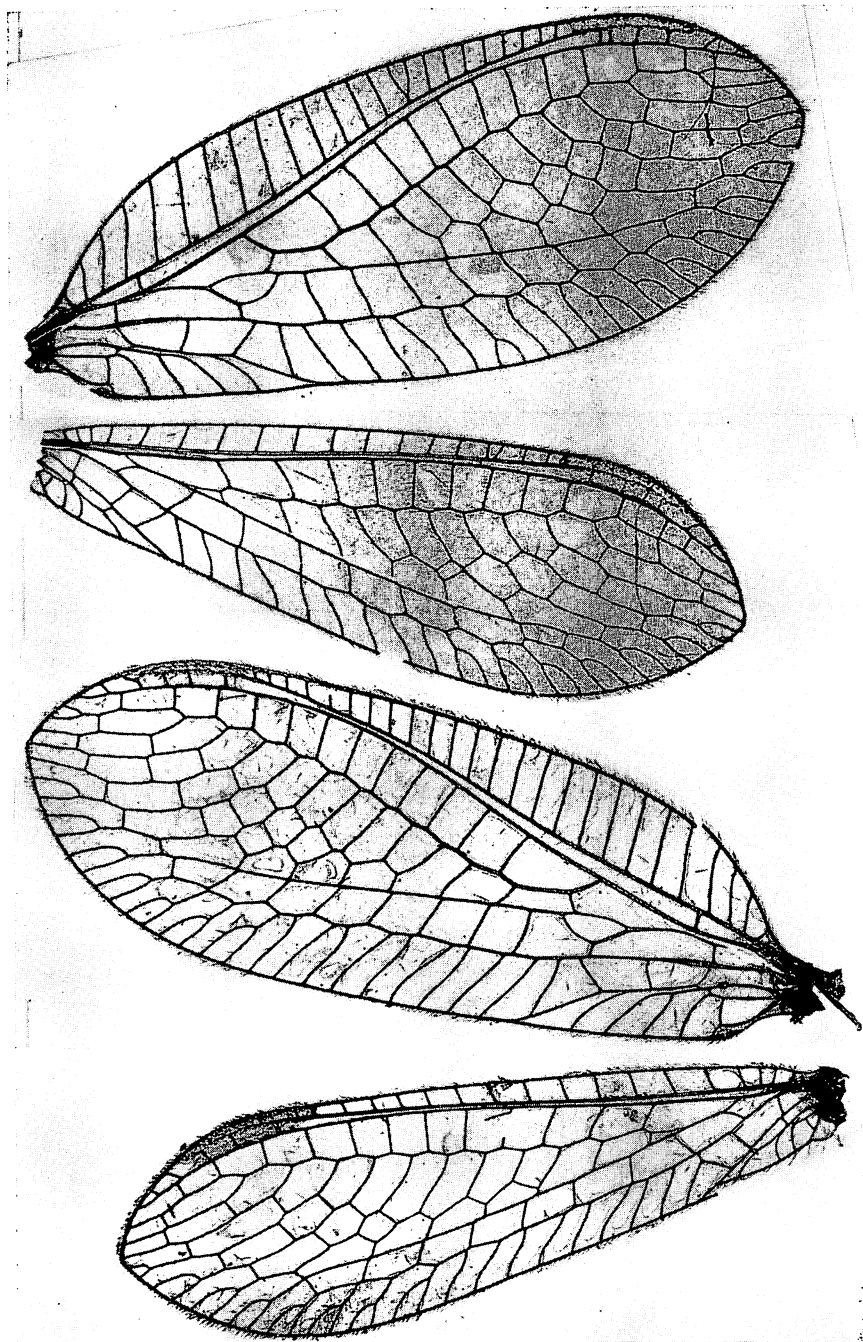


Figure 60—Wings of *Anomalochrysa frater* Perkins. Above: Holotype; Kona; fore wing length, 12.5 mm. Below: A female from Kilauea; fore wing length, 13 mm.

an organ that I thought at first that the abdomen did not belong to the specimen dissected, or that some other abnormality was being examined. Further study revealed, however, that it is a character of female *frater*. Why such an unusually divergent organ should develop in this one species is difficult to explain. As the illustrations show, there is remarkably little difference in the spermatheca in the other species of the genus.

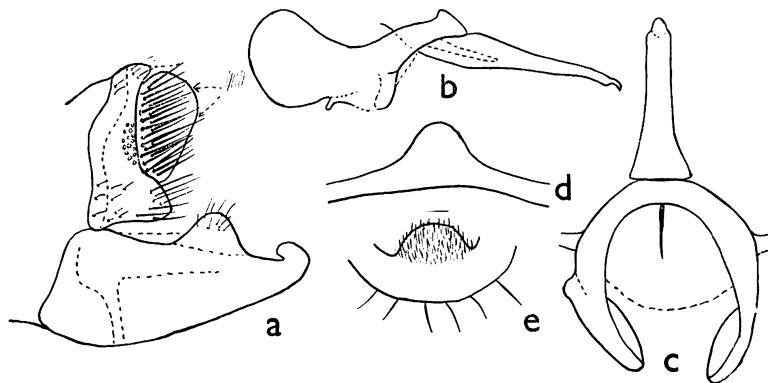


Figure 61—Male genitalia of *Anomalochrysa frater* Perkins, holotype. **a**, lateral view (the stout setae on the dorso-caudal plate may be curved); **b**, **c**, lateral and dorsal views of tenth sternite and aedeagus; **d**, median sclerotization of subrectal sclerite; **e**, caudal view of apex of ninth sternite.

***Anomalochrysa fulvescens fulvescens*** Perkins (figs. 54, b; 62; 63; 64; 92, c, c'; 94, d).

*Anomalochrysa fulvescens* Perkins, 1899:60, pl. 3, figs. 14, 15, 16.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

This is one of the most remarkable of all of our chrysopids. It is highly variable. It, and its subspecies *rhododora*, may be at once separated from all other *Anomalochrysa* because vein 2A in the fore wing is widely separated from 1A, and the cross-vein between 1A and 2A is subequal in length to the cross-vein between 2A and 3A. In all of the other species, 2A so closely approaches 1A that the

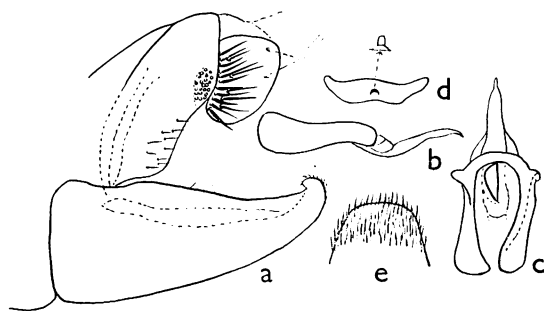


Figure 62—Male genitalia of *Anomalochrysa fulvescens* Perkins. **a**, lateral view; **b**, **c**, lateral and dorsal views of tenth sternite and aedeagus; **d**, median sclerotization of subrectal sclerite with another view of median protuberance; **e**, ventro-caudal view of apex of ninth sternite.

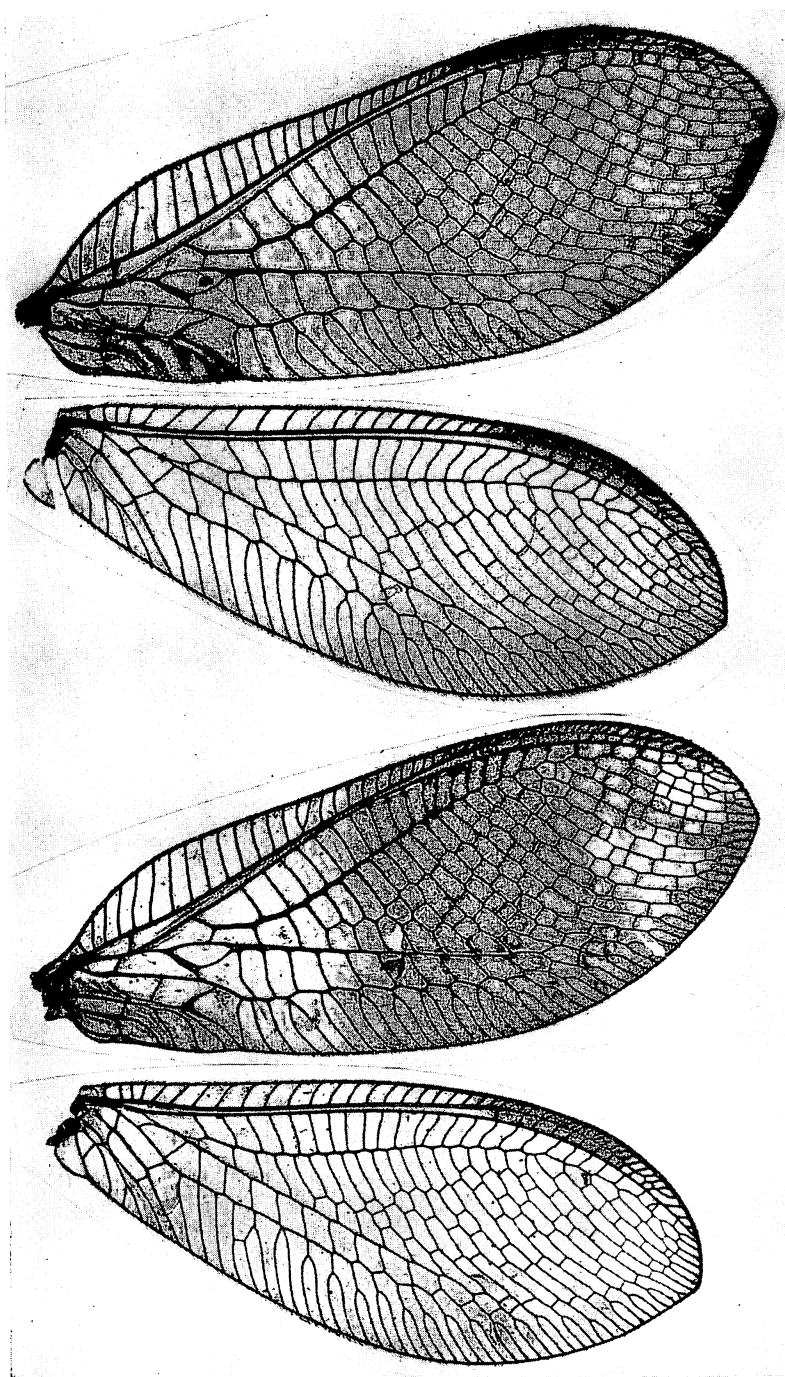


Figure 63—Wings of *Anomalochrysa fulvescens* Perkins. Above: Holotype male; Haleakala, Maui; fore wing length, 15 mm. Below: Paratype male; Haleakala, 5,000 feet; fore wing length, 16 mm.



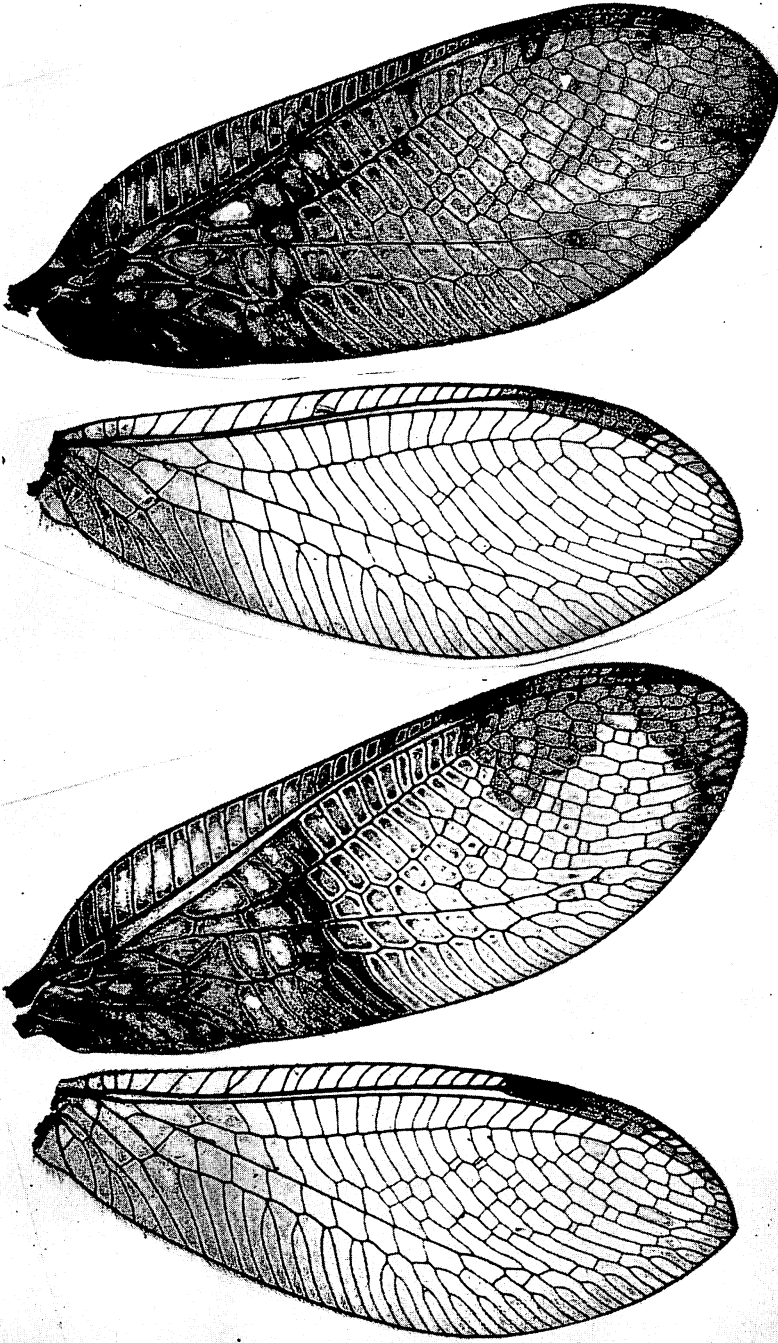


Figure 64—Wings of *Anomalochrysa fulvescens* Perkins. Above: Female paratype; Haleakala, Maui, 5,000 feet; fore wing length, 16 mm. Below: Another female paratype with the same data; fore wing length, 16.5 mm.

cross-vein between the two veins is greatly reduced or becomes obsolete. This character has escaped notice heretofore.

In the fore wings the dividing cross-vein of the third cubital cell apparently joins the base of the distal side of the cell in a swelling of M. The third cross-vein from Cu<sub>1</sub> beyond the origin of Cu<sub>2</sub> joins the wing margin. The wings are strongly fulvescent, especially the anterior pair, which are often mottled with variable spots and areas. The veins are always strongly colored. The illustrations demonstrate some of the variations in color pattern.

**Anomalochrysa fulvescens** subspecies **rhododora** (Perkins), **new combination** (figs. 53; 65).

*Anomalochrysa rhododora* Perkins, 1899:60.

*Anomalochrysa rhododora* variety *xerophylla* Perkins, 1899:61 (type locality: Kilauea). Synonymy by Zimmerman, 1940:493.

Endemic. Hawaii (type locality: Kau, 4,000 feet).

I believe that to consider *rhododora* as a subspecies of *fulvescens* more accurately expresses its relationship than to maintain it as a distinct species. In appearance, because of its color, it is quite distinctive, and no typical *fulvescens* have been found on Maui. Perkins did not give the type locality in his original description.

Perkins (1899:61) had the following to say regarding his *xerophylla*: "The insect in a resting position bears an extraordinary resemblance to a small dead leaf that has been attacked by insects." Additional specimens blending between the types of *rhododora* and *xerophylla* led me to submerge the latter name.

**Anomalochrysa haematura** Perkins (figs. 65; 94, e).

*Anomalochrysa haematura* Perkins, 1899:58. Zimmerman, 1940:491.

Endemic. Oahu (type locality: "near Honolulu," 3,000 feet; the female holotype is labeled Koolau Range, 3,000 feet).

This species appears allied to *rufescens*, and its status is not entirely clear. No females have been found. Is it a good species?

**Anomalochrysa hepatica** McLachlan (figs. 55; 66; 67; 68; 92, d, d'; 94, f).  
Type of the genus.

*Anomalochrysa hepatica* McLachlan, 1883:299. Perkins, 1899:59, pl. 3, fig. 10; pl. 4, fig. 17.

*Anomalochrysa proteus* Perkins, 1899:59, pl. 3, figs. 11, 12, 13. Synonymy by Zimmerman, 1940:491.

Endemic. Oahu, Molokai, Maui (type locality: Haleakala, about 4,000 feet), Hawaii.

Williams (1931:131) lists this (under the name *proteus*) as one of the species which has been found feeding on aphids in sugarcane fields.

The males share with *frater* the unusual character of having the hair on the abdominal tergites long, coarse, erect and directed toward the thorax.

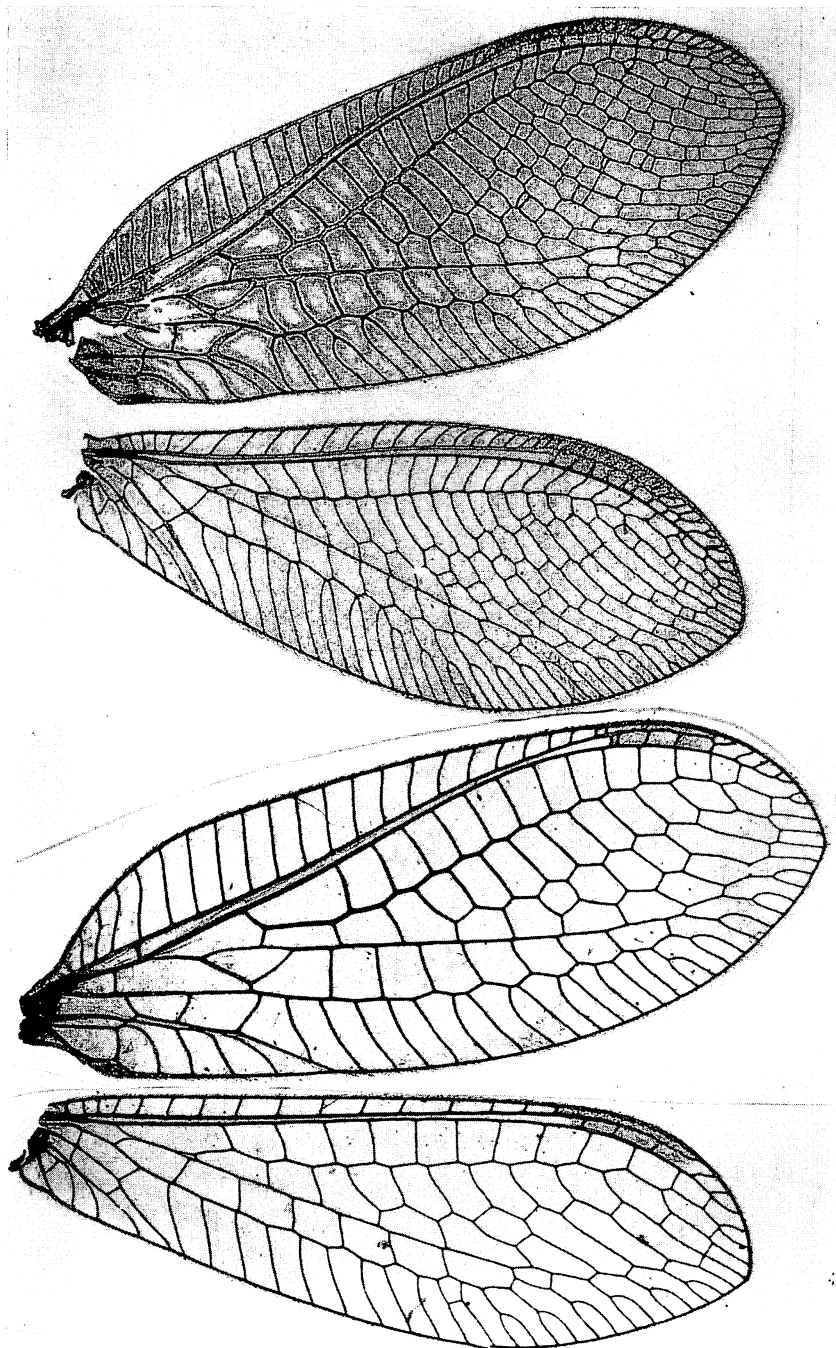


Figure 65—Wings of *Anomalochrysa fulvescens rhododora* (Perkins). Above: Male holotype; fore wing length, 15.5 mm. Below: *haematura* Perkins, holotype female; Koolau Range, Oahu; fore wing length, 14.5 mm.

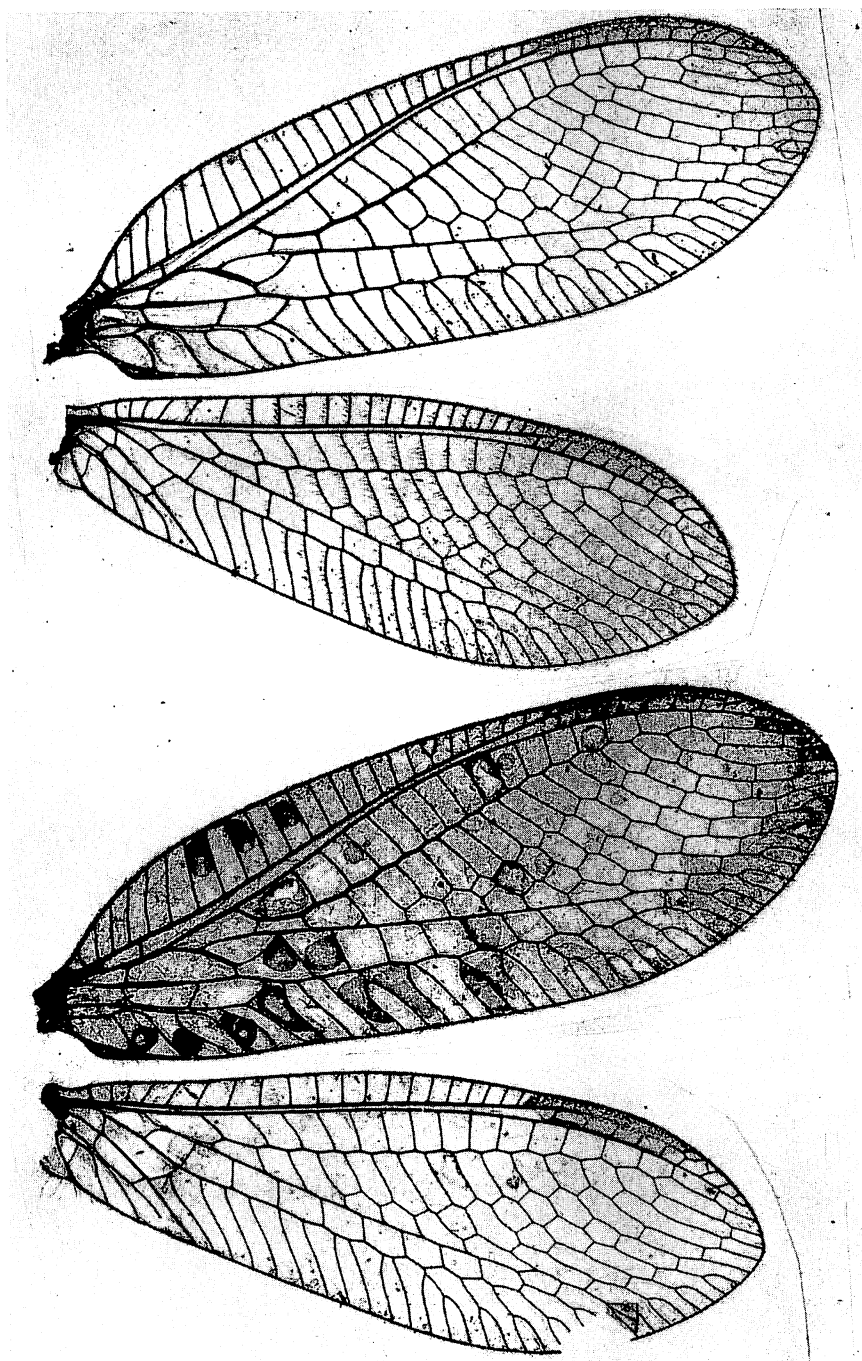


Figure 66—Wings of *Anomalochrysa hepatica* McLachlan. Above: From the holotype male of *proteus* Perkins, from Kau; fore wing length, 15 mm. Below: A female *proteus* paratype from Kau, 4,000 feet; fore wing length, 14.5 mm.

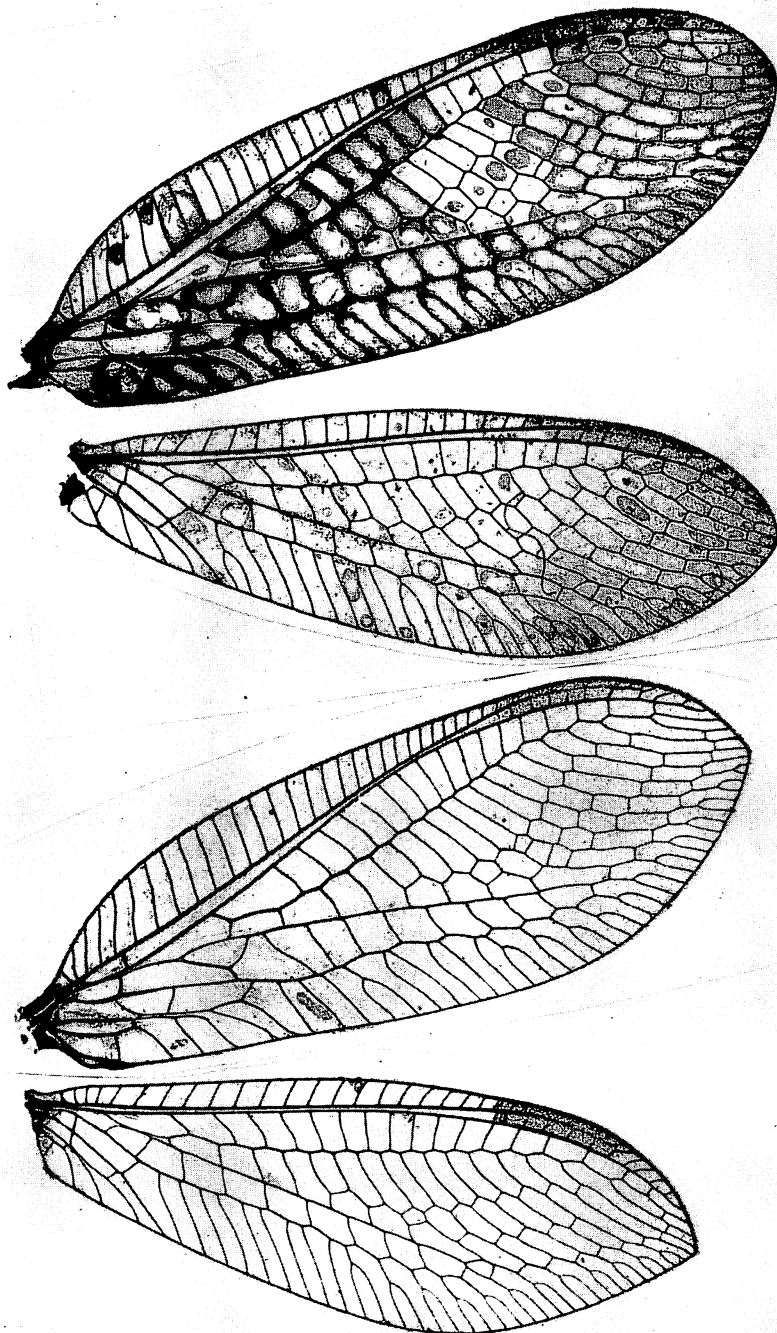


Figure 67—Wings of *Anomalochrysa hepatica* McLachlan. Above: From a paratype female of *proteus* Perkins, from Kau, 4,000 feet; fore wing length, 16 mm. Below: *longipennis* Perkins, holotype female; Kau; fore wing length, 19 mm.

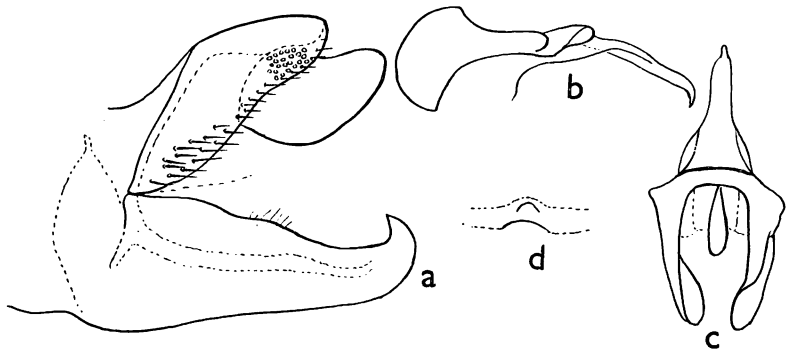


Figure 68—Male genitalia of *Anomalochrysa hepatica* McLachlan. **a**, lateral view (the dorso-caudal plate is covered with fine hairs only); **b**, **c**, lateral and dorsal views of tenth sternite and aedeagus; **d**, median part of subrectal sclerite.

***Anomalochrysa longipennis* Perkins (figs. 67; 92, f, f'; 94, g).**

*Anomalochrysa longipennis* Perkins, 1899:53, pl. 3, fig. 5.

Endemic. Hawaii (type locality: Kau, 4,000 feet). Perkins stated in his original description that the unique female holotype was taken in August, 1896, at Kilauea, but it is labeled Kau, December, 1896.

This is an ally of *maclachlani* and may be a form of that variable species.

***Anomalochrysa maclachlani maclachlani* Blackburn (figs. 53; 54, a, c; 69; 70; 71; 72; 92, g, g'; 94, h).**

*Anomalochrysa maclachlani* Blackburn, 1884:418.

*Anomalochrysa deceptor* Perkins, 1899:54, pl. 3, fig. 6; pl. 4, figs. 19, 19a (type localities: male holotype, Puna, Hawaii; female allotype, Kau, Hawaii, 4,000 feet). Synonymy by Zimmerman, 1940:492.

*Anomalochrysa gayi* Perkins, 1899:56, pl. 3, fig. 7 (type localities: holotype male, Waimea, Kauai, 4,000 feet; allotype female, Halemanu, Kauai, 4,000 feet).

**New synonym.**

*Anomalochrysa paurosticta* Perkins, 1899:53 (type locality: erroneously stated to be "Olaa, Hawaii, 2,000 ft." in *Fauna Hawaiiensis*, but the male holotype is labeled Puna, Hawaii, December, 1896). **New synonym.**

*Anomalochrysa paurostica*, Zimmerman, 1940:492, 495, 500. Typographical error.

*Anomalochrysa zoe* Perkins, 1899:56 (type locality: Molokai, 4,000 feet). Zimmerman, 1940:494. **New synonym.**

Endemic. Kauai, Oahu, Molokai, Maui, Hawaii (type locality: Mauna Loa, 6,000 feet).

The left wings are the only fragments remaining of Blackburn's male holotype, and they are in the Bishop Museum.

Terry (1905:174) and Williams (1931:131) say that this species (under the names *deceptor* and *gayi*) visited sugarcane fields in earlier days to prey upon aphids and young sugarcane leafhoppers.

This is an extraordinarily variable and confusing species. The type of *gayi*, from Kauai, has the posterior (cubital) side of the third cubital cell very long—as long or longer than the corresponding side of the second cubital cell. I have seen similar examples from Hawaii. Other specimens from various localities intergrade to the typical form of *maclachlani* which does not have the cell so elongated. I consider that *gayi* is simply an extreme form of *maclachlani*, in so far as this character is concerned, and I consider it to be a synonym.

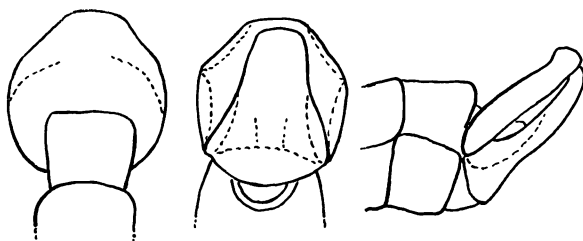


Figure 69—Male genitalia of *Anomalochrysa maclachlani* Blackburn. Dorsal, ventral and lateral views as seen in a dried specimen. Note the ninth sternite (ventral valve) closed against the tenth tergite. The numerous setae have been omitted.

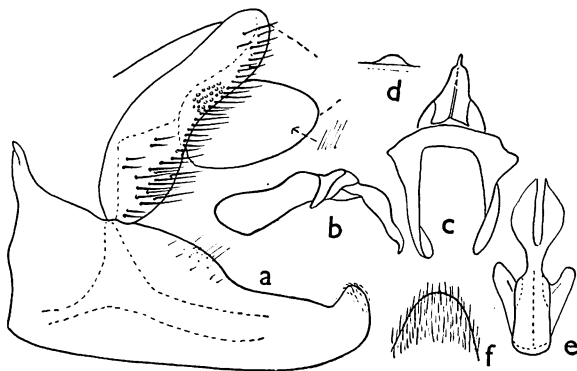


Figure 70—Male genitalia of *Anomalochrysa maclachlani* Blackburn. **a**, lateral view; **b**, **c**, lateral and dorsal views of tenth sternite and aedeagus; **d**, median sclerotization of subrectal sclerite; **e**, hypandrium; **f**, caudal view of apex of ninth sternite. Figure **e** from the holotype of *gayi* Perkins; the others from the holotype of *deceptor* Perkins.

The female holotype of the form called *paurosticta* by Perkins was the only one he had, and I consider it to be just one of the many variable types of individuals produced in this species, and it should be reduced to synonymy.

I do not know why Perkins described *zoe* when he was so familiar with the extreme variability of *maclachlani*. (Although Perkins did not mention the fact, Zoe was the name of his first wife, Zoe Lucy Sherrard Atkinson, daughter of

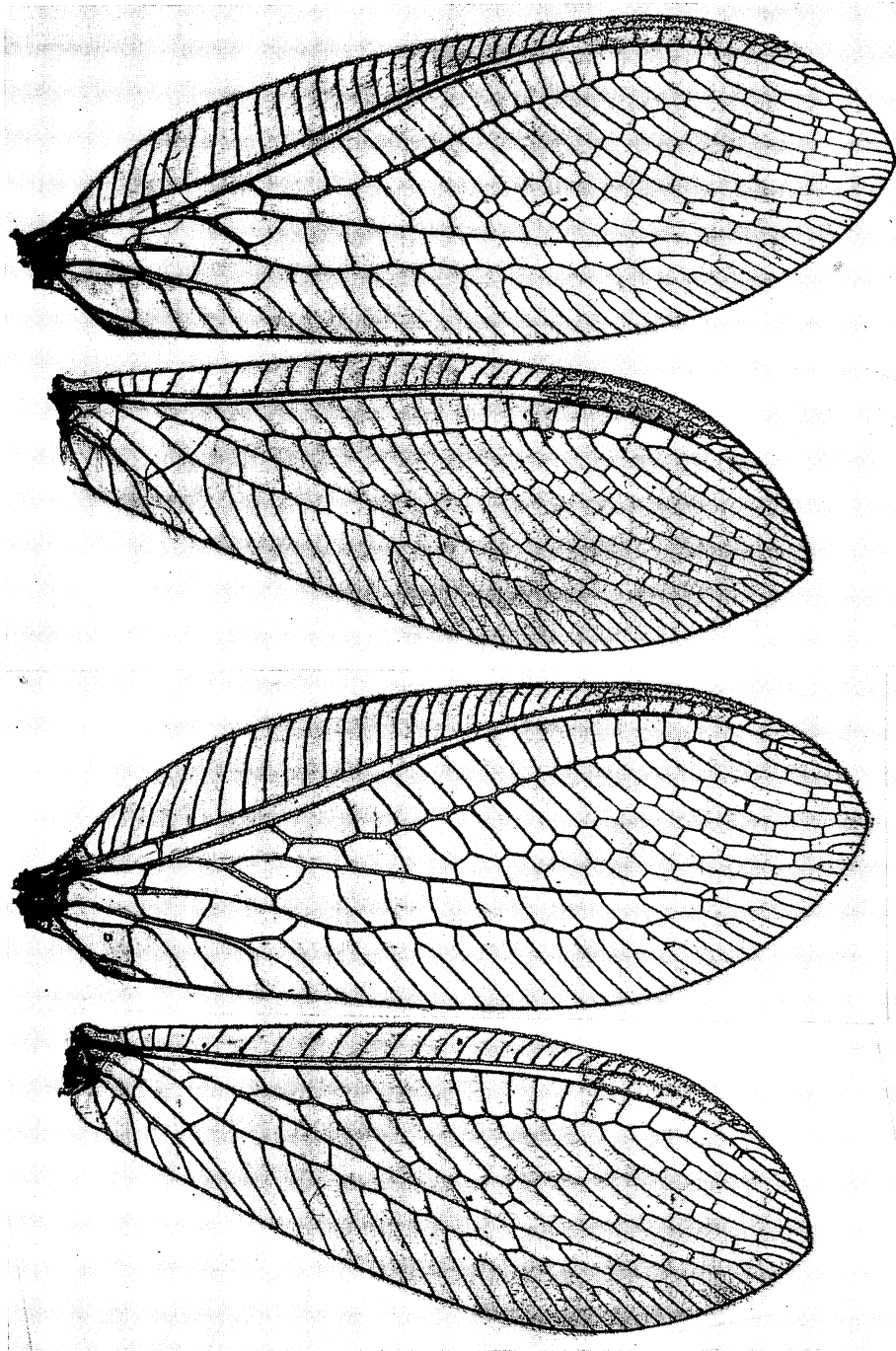


Figure 71—Wings of *Anomalochrysa maclachlani* Blackburn. The top figure is from the male holotype of *deceptor* Perkins, Puna, Hawaii; fore wing length, 15 mm. The bottom figure is from the male holotype of *zoe* Perkins, Molokai mountains, fore wing length, 15.5 mm.



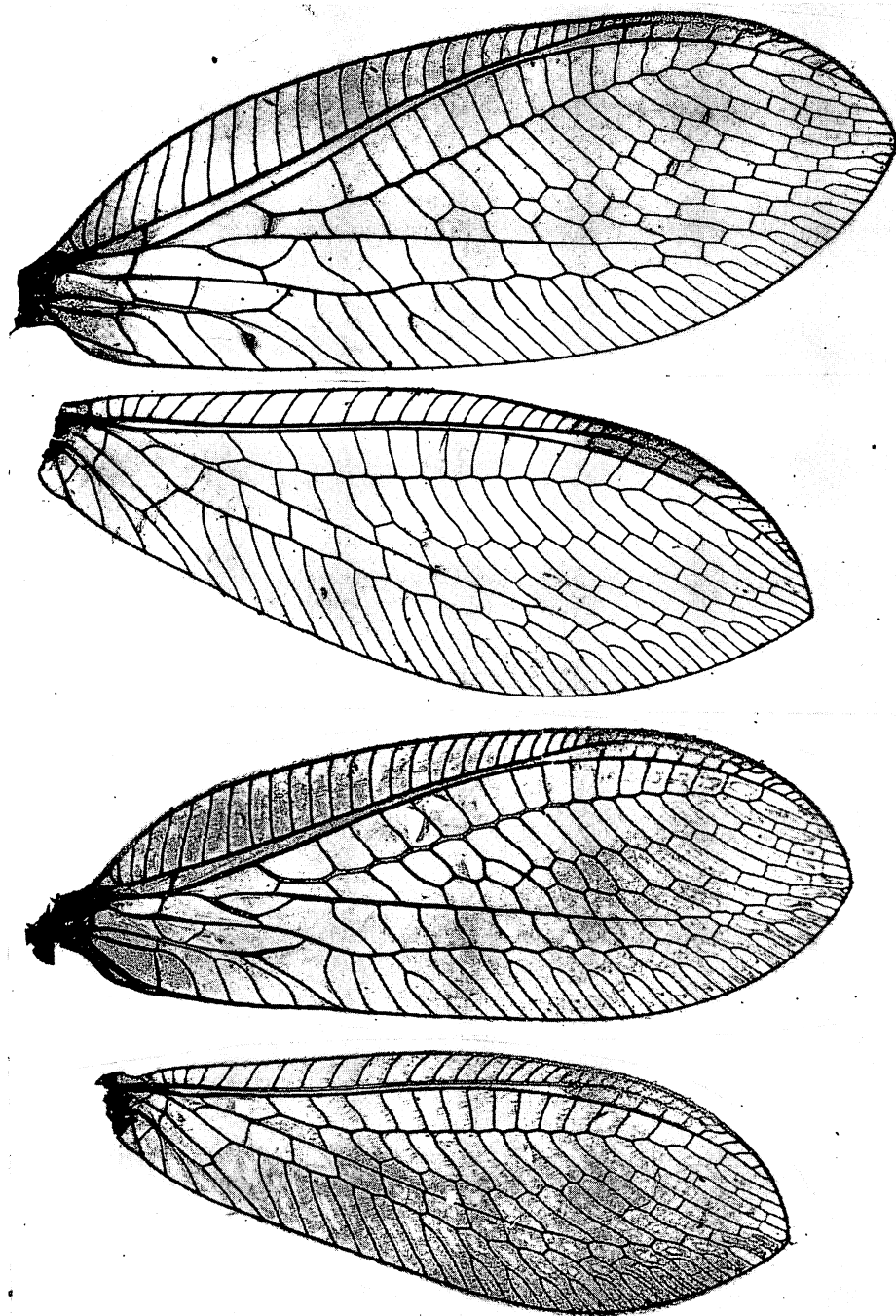


Figure 72—Wings of *Anomalochrysa maclachlani* Blackburn. The top figure is from the holotype female of *paurosticta* Perkins, Puna, Hawaii; fore wing length, 17.5 mm. The bottom figure is of the holotype male of *gayi* Perkins, Waimea, Kauai; fore wing length, 16.5 mm. Compare the variable lengths of the posterior sides of the third cubital cells in the four specimens illustrated in this figure and in figure 71.

Alatau Tamchiboulac Atkinson, one-time superintendent of public schools in Hawaii.) Although Perkins discussed variation between individuals in *zoe*, only one specimen, the male holotype, is in the *Fauna Hawaiiensis* collection in the British Museum. In this type (figure 71), the distal side of the third cubital cell meets  $Cu_1$  at the base of the fifth cross-vein from  $Cu_1$ . On the male holotype of Perkins' *deceptor*, the distal side of the third cubital cell meets  $Cu_1$  half way between the fourth and fifth cross-veins from  $Cu_1$ . The same condition exists in the allotype female of *deceptor*. If this were a constant feature and were supported by other constant differences it might be considered as of specific value, but it is not constant. There are six paratypes of *deceptor* in the British Museum, and the following variation is noted: On one example the distal side of the cell is as in the type of *zoe* in the left wing, but it joins  $Cu_1$  at two-thirds the distance between the fourth and fifth cross-veins in the right wing. In other specimens there is also variation between the right and left wings, and we may conclude that the distal side of the third cubital cell in *maclachlani* may join  $Cu_1$  at any point from about one-third the distance from the fourth and fifth cross-veins from  $Cu_1$  to the base of the fifth cross-vein to make all extremes between the most conservative form and the most extreme form such as the type of *gayi*.

The number of rows of gradate cells in both pairs of wings is also subject to considerable variation. There may be four or five or even six rows in the fore wings, and in the hind wings there may be three, four or even a partial fifth row.

Perkins did not recognize *maclachlani* when he wrote his monograph; he only listed the name without comment. He had the following to say about his *deceptor* (1899:54):

This is a very variable species, and the extreme forms are totally unlike one another in general appearance.

The following three forms of coloration no doubt constantly occur.

(1) Head, thorax and abdomen entirely flavous, or partly greenish (in life probably sometimes entirely green). (2) Abdomen and sides of the thorax yellowish or green, face yellow or pink, and a crimson stripe extending from the front of the vertex of the head to the mesothorax, antennae at the base in these examples often pink. (3) Whole body dark brown, or with the meso- and meta-thorax, or one of these parts more or less pale green or yellow.

Intermediate forms occur, e.g. a large part of the thorax may be yellow or greenish, the abdomen dark, and the face pink, etc.

The wings also vary, and may be hyaline and colourless, or themselves slightly greenish, or they may be whitish and opaque; nor is this condition of the wings confined to examples with a particular colouration of the body. These white-winged examples generally have dark spots on the anterior pair, but this is not invariably the case, and the spots are generally few, and confined to the base of the wing along the dorsal margin, but sometimes are more extensive.

The nervuration is always pale, green or yellow, except that the gradate nervures are usually, if not always, more or less dark, and the dorsal margin of the anterior wings is sometimes pink.

This species confused Perkins in later years, and he left supplementary material undetermined or with questioned determinations.

**Anomalochrysa maclachlani** subspecies **simillima** (Perkins) (figs. 54, d; 73; 74; 93, g, g'; 95, a), **new status**.

*Anomalochrysa simillima* Perkins, 1899:55. Zimmerman, 1940:493.

Endemic. Kauai (type locality: "High Plateau," 4,000 feet; the holotype male and allotype female are labeled Waimea, 4,000 feet).

This is a form of *maclachlani*, and examples with typical *maclachlani* coloring

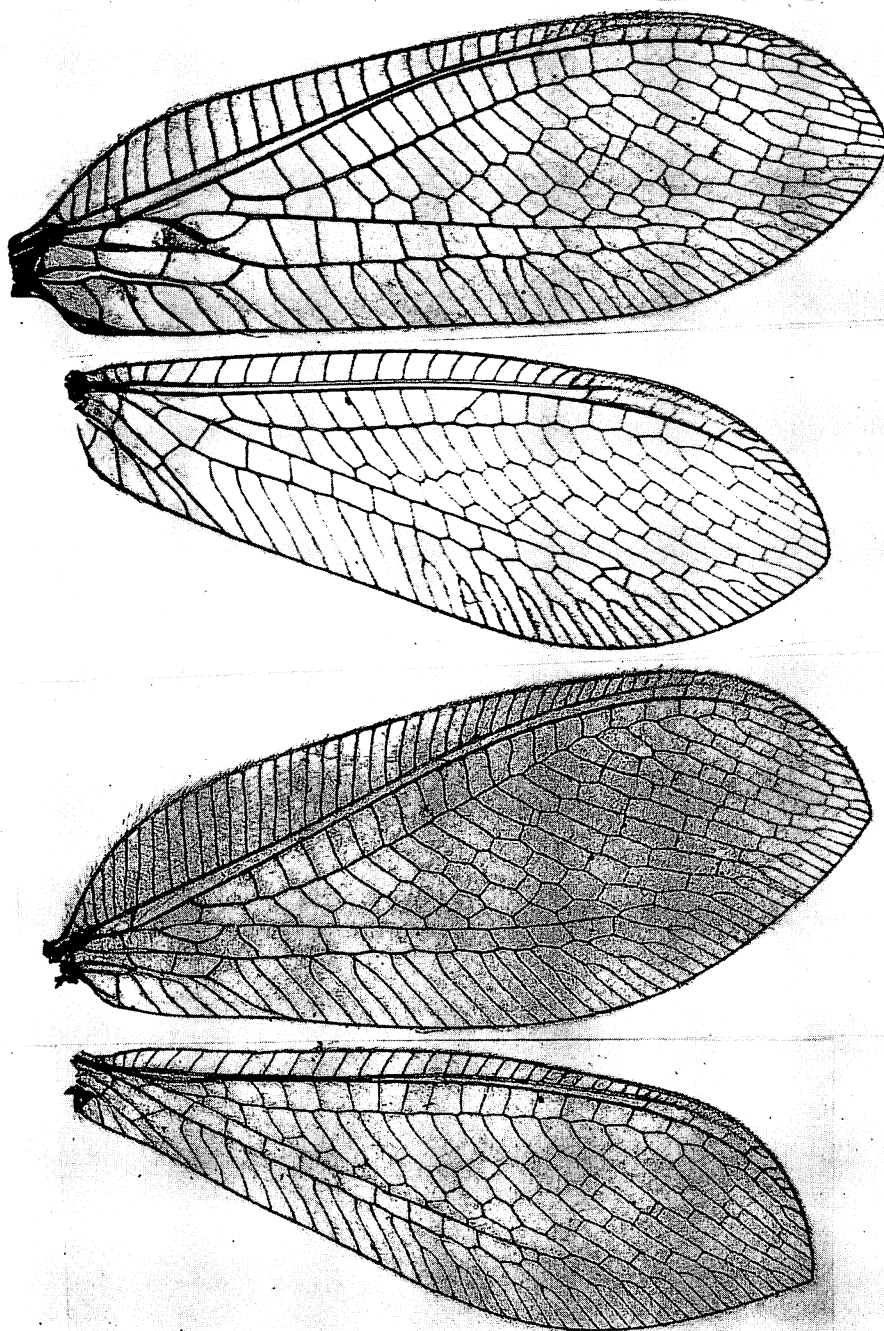


Figure 73—Wings of *Anomalochrysa maclachlani simillima* (Perkins), above: Male holotype from Waimea, Kauai; fore wing length, 15.5 mm. Below: *molokaiensis* Perkins, female holotype; Molokai, 4,000 feet; fore wing length, 21 mm.

have been examined. The wings on the specimens seen appear narrower than on typical *maclachlani* because the first series of gradate cells are less high and narrow. The closure of the cell between 3A and the wing margin in the fore wing is subject to some variation. I do not believe that this form is a fully distinct species, but it is different enough from typical *maclachlani* to be considered a subspecies. It may be that *maclachlani* has invaded Kauai two or more times, and it is possible that this form represents an earlier invasion of the species.

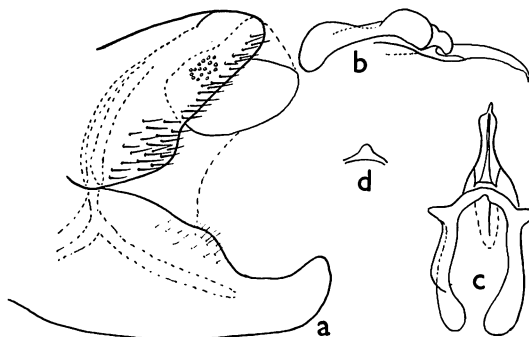


Figure 74—Male genitalia of *Anomalochrysa maclachlani simillima* (Perkins). **a**, lateral view; **b**, **c**, lateral and dorsal views of tenth sternite and aedeagus; **d**, median sclerotization of subrectal sclerite.

***Anomalochrysa molokaiensis* Perkins** (figs. 73; 92, h, h'; 94, i).

*Anomalochrysa molokaiensis* Perkins, 1899:48.

Endemic. Molokai (type locality: 4,000 feet).

This large, broad-winged species is known only from the female holotype, which is a teneral example. See the discussion under *sylvicola* for additional comment.

***Anomalochrysa montana* Blackburn** (figs. 75; 76; 93, a, a'; 94, j).

*Anomalochrysa montana* Blackburn, 1884:419. Perkins, 1899:49. Zimmerman, 1940:492.

Endemic. Hawaii (type locality: Mauna Loa, near 7,000 feet).

Perkins stated in *Fauna Hawaiiensis* that he found the species at Kilauea, but the single female in his collection in the British Museum is labeled Kau, 4,000 feet.

The unique type appears to have been destroyed. It should have been in the Blackburn collection, which Perkins sent to Bishop Museum, but, as noted under other Blackburn species, Blackburn's material was extensively damaged by museum pests, and it appears that the holotype was destroyed. We may, therefore, designate as neotype a male example collected by Perkins in July, 1903, at Kilauea, Hawaii, and which is in the Bishop Museum in Honolulu.

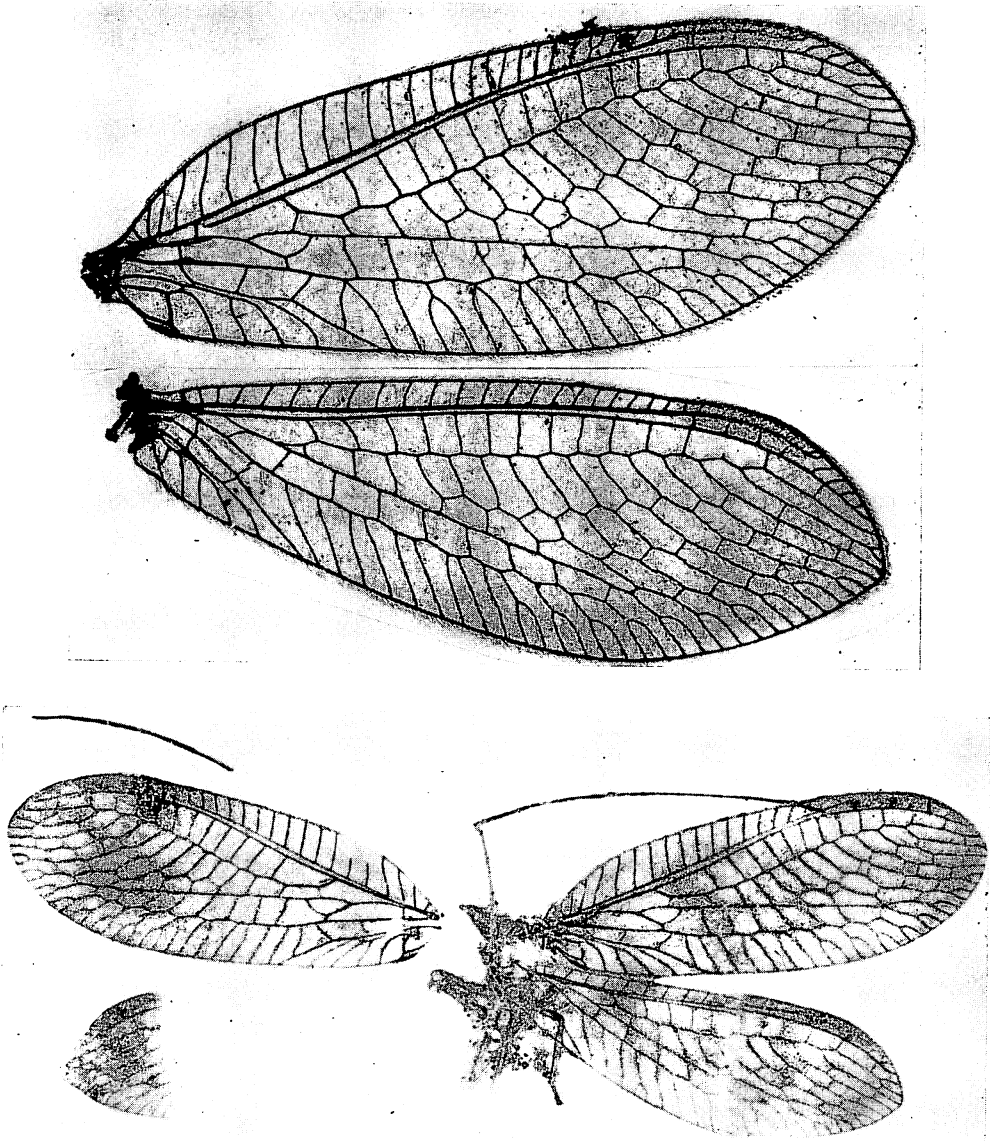


Figure 75—Above: Wings of *Anomalochrysa montana* Blackburn. Kau, 4,000 feet; fore wing length, 13.5 mm. Below: The fragments of the female type of *ornatipennis* Blackburn.

This form and *debilis* are confusingly similar. I have seen only one male, and its genitalia are, as the figures show, different from those of *debilis*. On the examples of this species seen, vein 1A in the *hind* wing is forked, but it is simple in all the specimens of *debilis* seen. This character might, however, be variable. The dorsal stripe is pink or red instead of yellow.

This species and *viridis* may appear rather closely similar. See the discussion under *viridis* for further details.

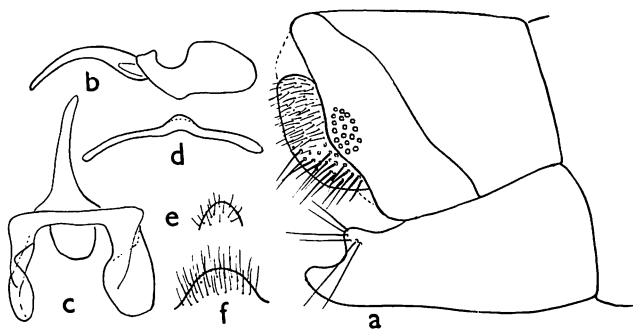


Figure 76—Male genitalia of *Anomalochrysa montana* Blackburn; an example determined by Perkins; Kilauea, Hawaii. **a**, lateral view; **b**, **c**, lateral and dorsal view of tenth sternite and aedeagus; **d**, subrectal sclerite; **e**, **f**, caudal and ventro-caudal views of apex of ninth sternite. This species can be separated from *viridis* because the dorso-caudal plate is clothed with spines which are not in groups, and because the apices are not flagellum-like.

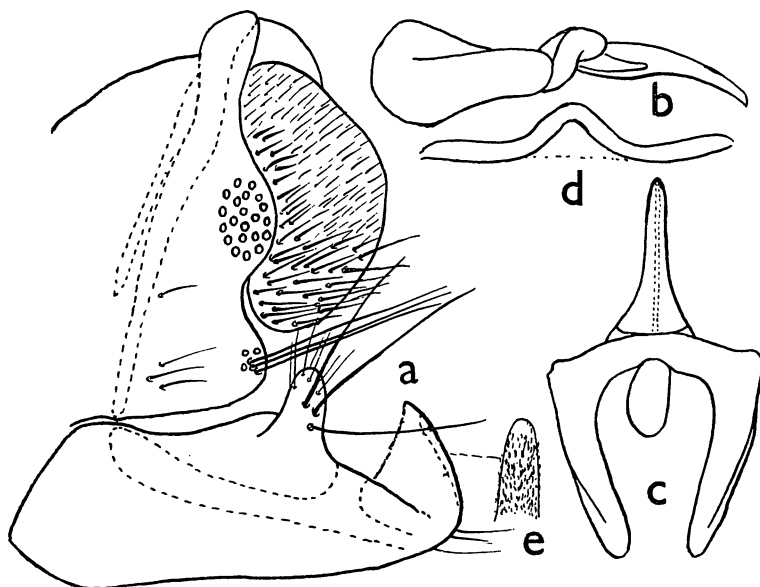


Figure 77—Male genitalia of *Anomalochrysa ornatipennis* Blackburn, from Kilauea, Hawaii. **a**, lateral view; **b**, **c**, lateral and dorsal views of tenth sternite and aedeagus; **d**, subrectal sclerite; **e**, caudal view of apex of ninth sternite.

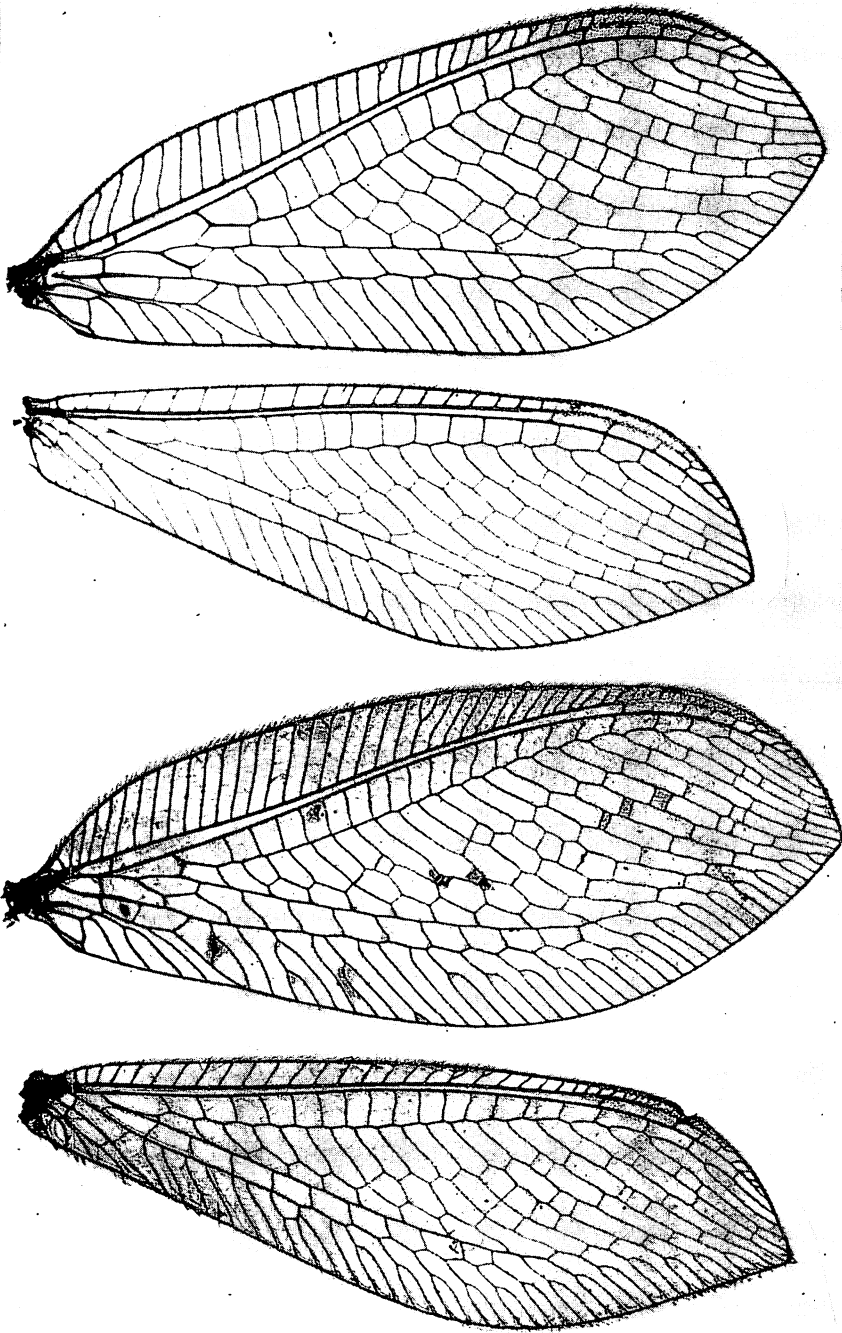


Figure 78—Wings of *Anomalochrysa peles* Perkins. Above: Type male; Kau, Hawaii; fore wing length, 15 mm. Below: *princeps* Perkins, male type; Kona, Hawaii; fore wing length, 20 mm. The form of the third cubital cell and the course of the dividing nervure is variable. On this illustration the shape of this cell recalls that of *Nathanica* Navás, which includes two British species, but, of course, this is merely an accidental resemblance, and the other characters are typically *Anomalochrysa*.

**Anomalochrysa ornatipennis** Blackburn (figs. 75; 77).

*Anomalochrysa ornatipennis* Blackburn, 1884:420. Zimmerman, 1940:492.

Endemic. Hawaii (type locality: Mauna Loa, about 4,000 feet).

This species has been known heretofore only from the unique, badly damaged female holotype in Bishop Museum; the body and most of the left hind wing have been destroyed. When Perkins wrote his *Fauna Hawaiiensis* report, he listed *ornatipennis* without comment, because he did not recognize it, and the original description is misleading. Blackburn called attention to certain dark wing spots which may not be usual or natural. Had Perkins seen Blackburn's type, however, he probably would not have described *frater*, because some females of *frater* can hardly be separated from the wing fragments of *ornatipennis*.

In Perkins' supplement to his *Fauna Hawaiiensis* report on the Neuroptera (1910:691) he stated:

At Kilauea, Hawaii, I have taken specimens of an *Anomalochrysa* agreeing well with *A. reticulata*, but they are rather small and, as in many other species, there is some variation in neuration. The male characters are remarkable. The apical dorsal plate is fringed with hairs and bears a specially developed stout spinose one on each side at the base; the apical ventral valve is hairy beneath, subtriangular, being subacute at the apex, which forms a recurved hook. The abdomen has the clothing normal, the hairs not directed basally, as in *A. frater*, which it much resembles.

I have studied these supplementary specimens, and I consider that they represent the male of *ornatipennis*. Perkins is in error in saying that the apical dorsal plate of the male genitalia has a "specially developed stout spinose" hair on each side at the base. What Perkins called a single spine is a cluster of hairs, as the illustration reveals, and it is a development found in a number of species.

I have not been able to recognize a female of *ornatipennis* (except the fragmentary type) and thus do not know if the structure of the spermatheca is or is not similar to that of *frater*. The male genitalia, as illustrated, are distinct in the two forms. I have examined several males of *frater*, and two males of *ornatipennis*, and the characters appear to be constant. The normal type of vestiture on the abdominal tergites of male *ornatipennis* serves as an easily recognizable character to separate it from the male of *frater*, which has the characteristic, long, erect, anteriorly directed hair. The two forms are otherwise outwardly very similar.

**Anomalochrysa peles** Perkins (figs. 78; 79).

*Anomalochrysa peles* Perkins, 1899:49. Zimmerman, 1940:492.

Endemic. Hawaii (type locality: the unique male holotype is labeled Kau, 4,000 feet, but in *Fauna Hawaiiensis* the type locality is stated to be Kilauea).

This species belongs to the group of delicate species with the long, erect hair in the middle of the pronotum. With only the type to study, nothing can be said regarding its variability and little about its relationships, but it belongs in association with *debilis* and *montana*.



***Anomalochrysa princeps*** Perkins (figs. 78; 80; 93, c, c'; 95, c).

*Anomalochrysa princeps* Perkins, 1899:47, pl. 3, fig. 1; pl. 4, figs. 20, 20, a.  
Zimmerman, 1940:492.

Endemic. Hawaii (type locality: Kona, 2,500 feet, male holotype; female allotype, 3,000 feet).

This is one of the finest and one of the most distinct species of the genus. It contains the largest specimens of *Anomalochrysa*. Esben-Petersen (1926:98) suggested that this species might be assigned to his Samoan *Austrochrysa*, but I would not remove it from its close Hawaiian allies. Should it be found that our *princeps* and the type of *Austrochrysa* belong to the same genus, then *Austrochrysa* will have to fall as a synonym of *Anomalochrysa*. The known material of *Austrochrysa* is inadequate for solving the problem.

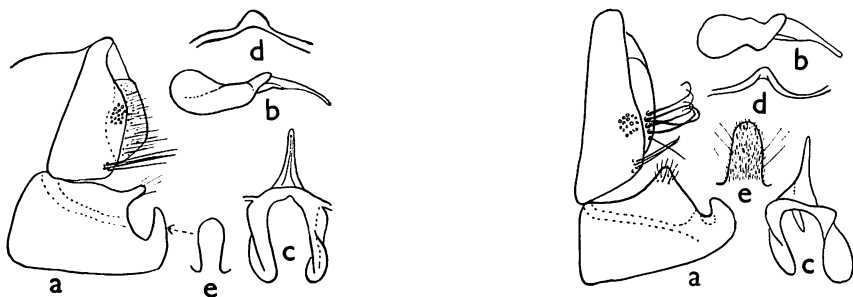


Figure 79—Male genitalia of *Anomalochrysa peles* Perkins, type. a, lateral view; b, c, lateral and dorsal view of tenth sternite and aedeagus; d, subrectal sclerite; e, caudal view of apex of ninth sternite, setae omitted. (Left.)

Figure 80—Male genitalia of *Anomalochrysa princeps* Perkins, type. a, lateral view; b, c, lateral and dorsal (oblique) views of tenth sternite and aedeagus; d, subrectal sclerite; e, caudal view of apex of ninth sternite. (Right.)

***Anomalochrysa raphidioides raphidioides*** Perkins (figs. 53; 81; 83; 93, d, d'; 94, a; 95, d).

*Anomalochrysa raphidioides* Perkins, 1899:57, pl. 3, fig. 8. Zimmerman, 1940:493.

Endemic. Hawaii (type locality: Kona, 5,000 feet).

Terry (1905:174) and Williams (1931:131) noted that this species has been observed feeding upon young sugarcane leafhoppers and aphids on sugar plantations.

The number of rows of gradate cells in the fore wings is subject to some variation, and there may be either three or four rows or partly three rows and partly four rows. The wings of the male are broader than those of the female.

In his original description, Perkins said "Prothorax attenuate in front, and conspicuously elongate." The prothorax is not elongate, and micrometer measurements of the holotype and allotype show that the prothorax is actually slightly broader than long. One using a hand lens might be misled as to the true proportions of the prothorax.

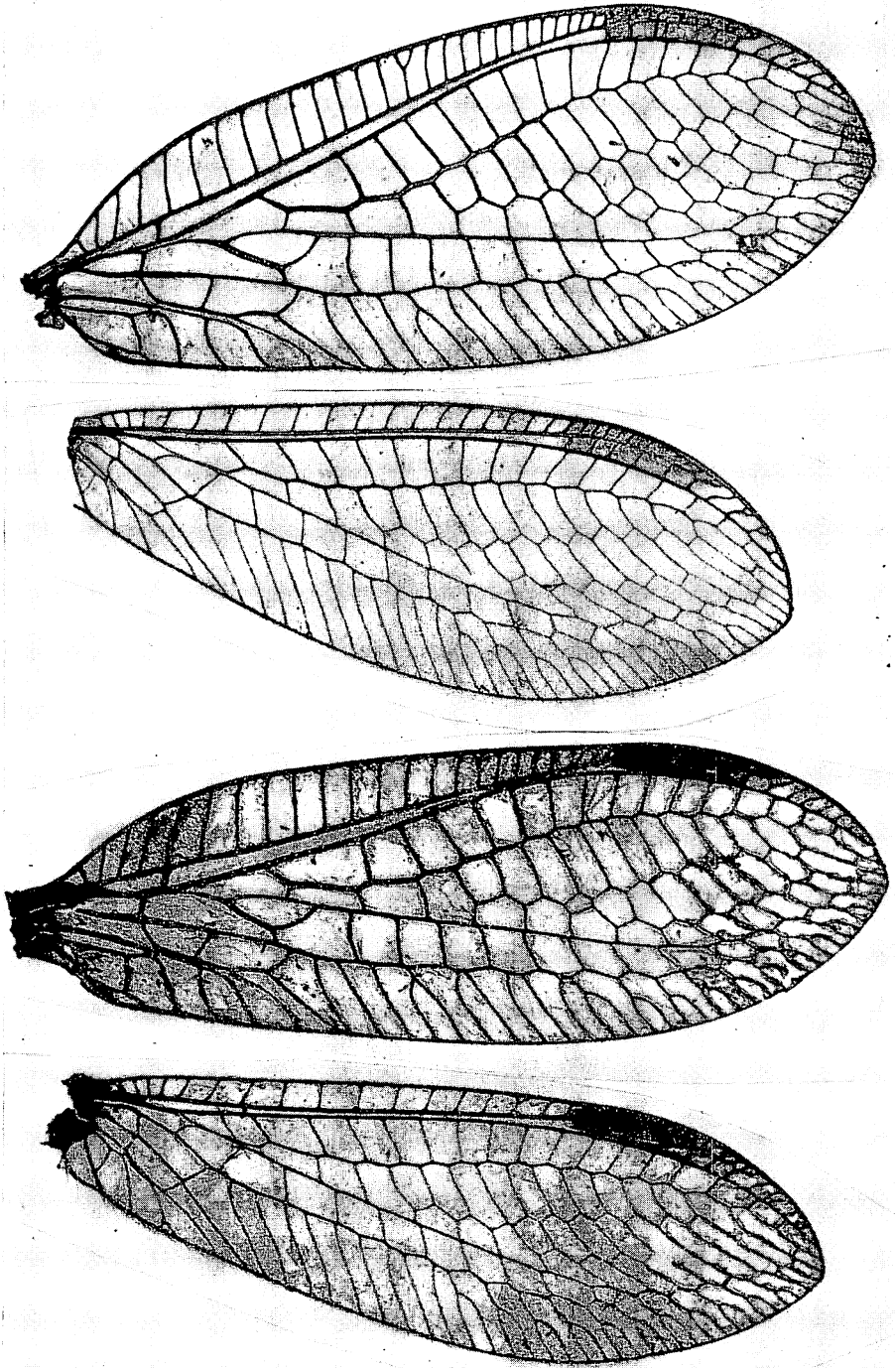


Figure 81—Wings of *Anomalochrysa raphidioides* Perkins. Above: Holotype, male; Kona, Hawaii; fore wing length, 16.5 mm. Below: A female paratype from Kona, Hawaii, 4,000 feet; fore wing length, 16 mm.

**Anomalochrysa raphidioides** subspecies **reticulata** (Perkins) (fig. 82), **new status.**

*Anomalochrysa reticulata* Perkins, 1899:57; 1910:691. Zimmerman, 1940:493.

Endemic. Hawaii (type locality: Kona, 4,000 feet).

Although Perkins placed this form immediately after *raphidioides* in *Fauna Hawaiiensis*, he stated that it is "probably allied to" *hepatica* (= *proteus*), which he placed five species farther on in his text. I believe that his female holotype of

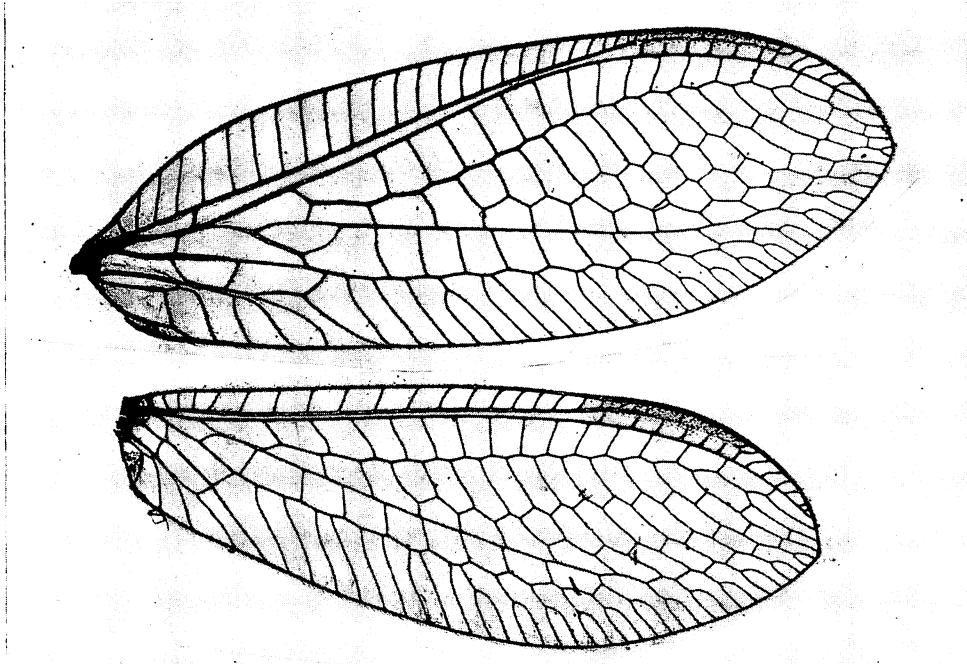


Figure 82—Wings of *Anomalochrysa raphidioides reticulata* (Perkins). Holotype, female; Kona, Hawaii; fore wing length, 15.5 mm.

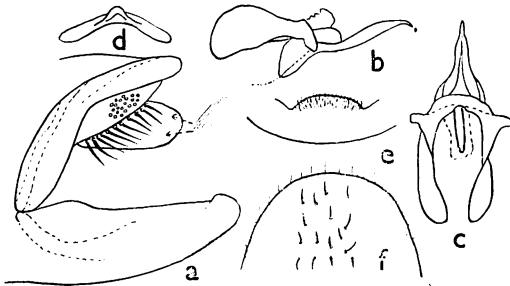


Figure 83—Male genitalia of *Anomalochrysa raphidioides* Perkins, holotype. **a**, lateral view; **b**, **c**, lateral and dorsal views of tenth sternite and aedeagus; **d**, subrectal sclerotization; **e**, **f**, caudal and ventral views of apex of ninth sternite.

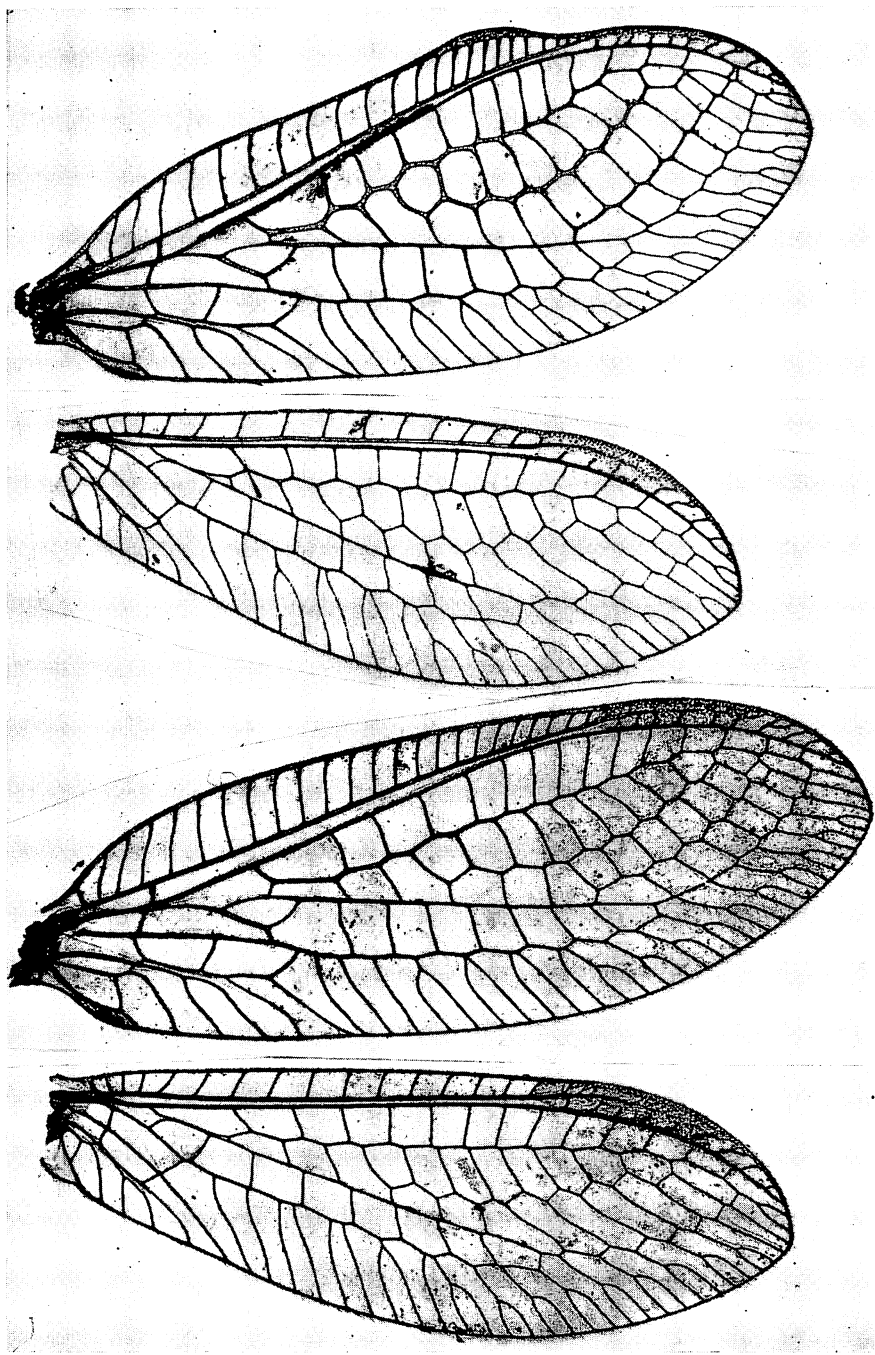


Figure 84—Wings of *Anomalochrysa rufescens* McLachlan. Above: Holotype, male; Oahu; fore wing length, 10 mm. Below: Paratype female from Oahu; fore wing length, 12 mm.

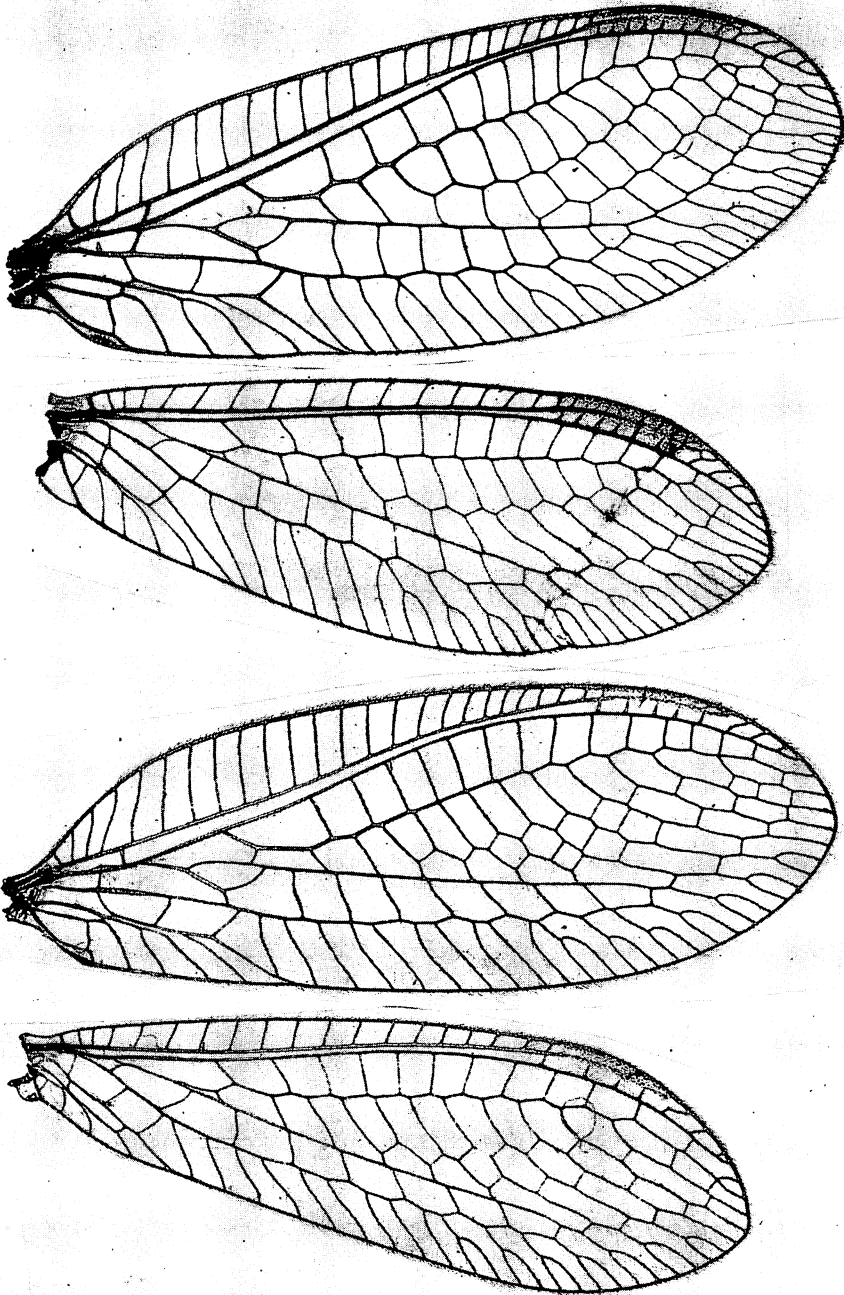


Figure 85—Wings of *Anomalochrysa rufescens* McLachlan. Above: From the female holotype of *biseriata* Perkins; Waianae Mountains, Oahu; fore wing length, 12.5 mm. Below: From *soror* Perkins, holotype male; Haleakala, Maui; fore wing length, 12.25 mm.

*reticulata* is a pale form of *raphidioides*. The lack of adequate material handicaps me here, and it may be found that this is not entitled to subspecific rank. Perhaps it is only a pale variety, but we must await further collecting before we can solve the problem. I have examined three females.

**Anomalochrysa rufescens** McLachlan (figs. 84; 85; 86; 93, e, e'; 95, e).

*Anomalochrysa rufescens* McLachlan, 1883:300. Zimmerman, 1940:493.

*Anomalochrysa biseriata* Perkins, 1899:58 (type locality: Waianae Mountains, 2,000 feet). Synonymy suggested by Perkins, 1910:687.

Endemic. Kauai, Oahu (type locality: the type bears only the Blackburn code sign indicating Oahu), Hawaii.

Williams (1931:131) says that this species has been found on sugarcane in the lowlands. I have seen a number of specimens collected at various times in Honolulu, and it is not infrequently found in Manoa Valley and in the vicinity of the University of Hawaii.

The male has the costa lobed just before the pterostigma, as illustrated. The lobing is quite distinct from that of *angulicosta*, as the figures will show.

I have compared Perkins' unique female type of *biseriata* with the McLachlan male and female types in the British Museum and confirm the synonymy.

**Anomalochrysa soror** Perkins (figs. 85; 87; 93, f, f'; 95, f).

*Anomalochrysa soror* Perkins, 1899:51. Zimmerman, 1940:493.

Endemic. Maui (type locality: Haleakala, 5,000 feet). It has been found on West Maui as well as on Haleakala.

This species belongs to the *viridis*-complex in association with *frater*. It may be distinguished from both species because its fore wings are rounded instead of angulate at their apices. The abdominal tergites of the males have fine, posteriorly directed hairs like those on *viridis*, in contrast to the coarse, erect, anteriorly inclined and usually dark hairs of *frater*. Perkins (1899:51) stated that it was closely allied to *viridis*, "but probably of smaller average size, with narrower wings, and the nervuration, which is green, paler. It may be known at once by the shape of the wings which are almost perfectly rounded at their apices, instead of forming a distinct angle thereat."

**Anomalochrysa sylvicola** Perkins (figs. 88; 93, h, h'; 95, g).

*Anomalochrysa sylvicola* Perkins, 1899:48, pl. 3, fig. 2. Zimmerman, 1940:493.

Endemic. Kauai (type locality: "High Plateau," 4,000 feet; the holotype male is labeled Waimea, 4,000 feet), Oahu.

This species was evidently described from one pair from Kauai, although Perkins did not say anything about the number of specimens he had when he described the species. The only example in the British Museum is the holotype male. The allotype female is now in the Bishop Museum in Honolulu.

Perkins described *molokaiensis* from a single teneral female which he found "drowning in a pool of water." Except for size and the accompanying differences in the number of propterostigmatic cells and a more complex arrangement in the gradate fields, I have been unable to find good external differences to distinguish these two species on the basis of known specimens. There are, however, some differences in the female genitalia, as illustrated. The male of *molokaiensis* is unknown, but it may display additional differences. Perkins gave the expanse of *molokaiensis* as 43 mm. and that of *sylvicola* as 35 to 37 mm. The type of *molokaiensis* has 39 or 40 propterostigmatic cells. The type of *sylvicola* has about 29 on the left side and 34 on the right side. A female example collected by D. E. Hardy at Makaleha, Oahu, is intermediate in size and has 31 propterostigmatic cells in the left wing and 35 in the right wing. It also displays some differences in venation, and the wings of the two sides are different. In the right fore wing the distal branch of 2A is forked, but it is simple in the left wing. In the left hind wing there are four gradate series at one place, but there are only three in the right wing. Another female, collected by E. J. Ford, Jr. on the Poamoho Trail, Oahu, is about 40 mm. in expanse, but it has only 25 or 26 propterostigmatic cross-veins. In the type of *molokaiensis* (which is the largest specimen of *Anomalochrysa* known excepting examples of the giant *princeps*) there is a tendency to form five rows of gradate cells in both pairs of wings. *Anomalochrysa sylvicola* and *molokaiensis* appear to be closely allied, and they may prove not to be specifically distinct.

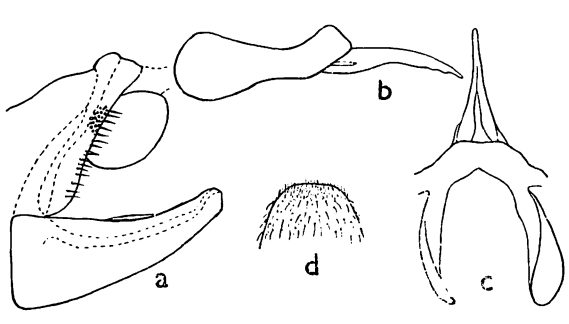


Figure 86

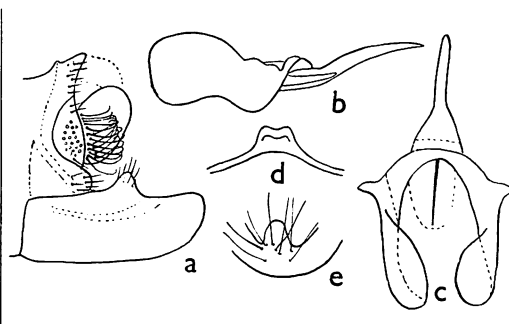


Figure 87

Figure 86—Male genitalia of the holotype of *Anomalochrysa rufescens* McLachlan. **a**, lateral view; **b**, **c**, lateral and dorsal views of tenth sternite and aedeagus; **d**, ventro-caudal view of apex of ninth sternite. The subrectal sclerite is inconspicuous. The dorso-caudal plate is clothed with fine hair.

Figure 87—Male genitalia of holotype of *Anomalochrysa soror* Perkins. **a**, lateral view; **b**, **c**, lateral and dorsal views of tenth sternite and aedeagus; **d**, subrectal sclerite; **e**, caudal view of apex of ninth sternite.

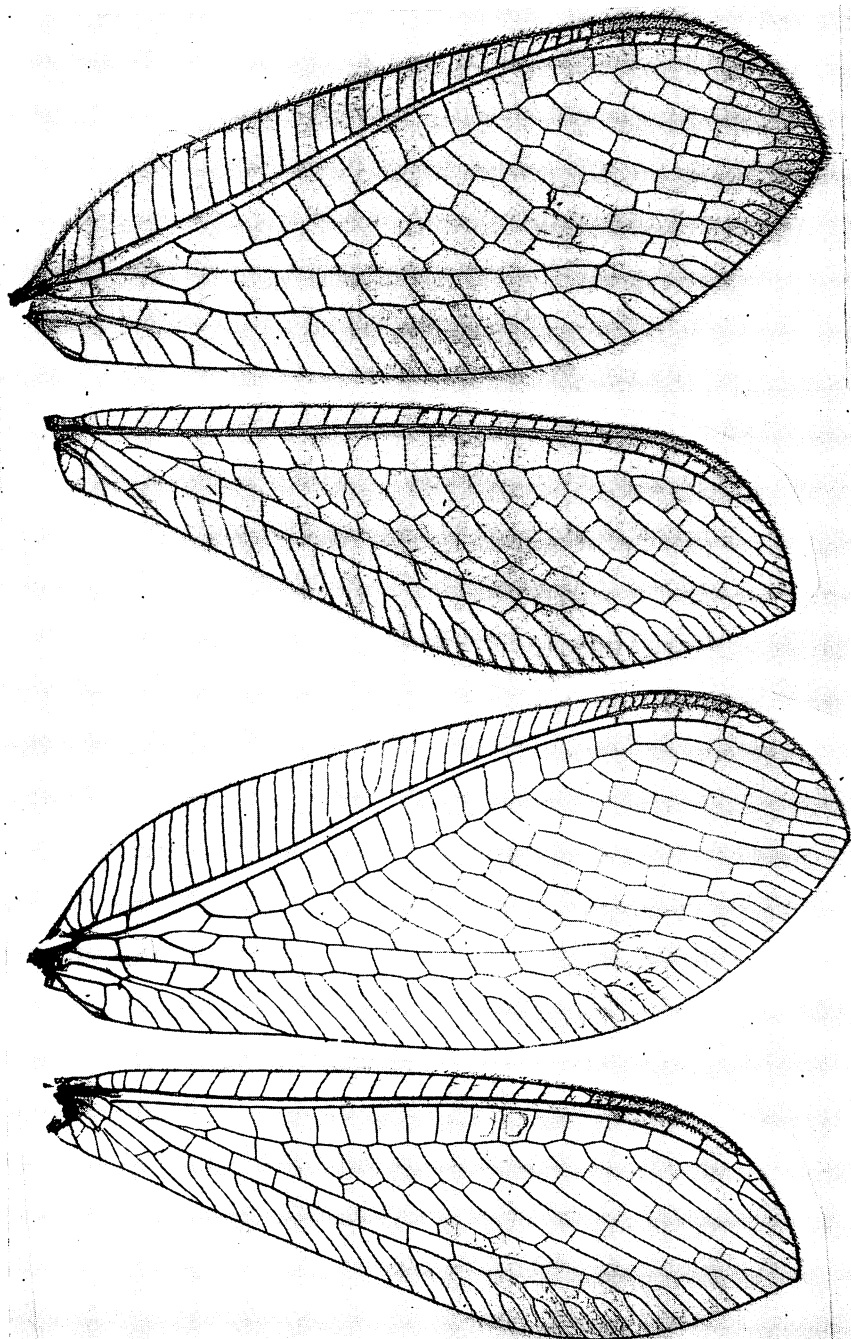


Figure 88—Above: Wings of the holotype of *Anomalochrysa sylvicola* Perkins; Waimea, Kauai; fore wing length, 16 mm. Below: Wings of a female from Makaleha, Oahu; fore wing length, 17.5 mm.



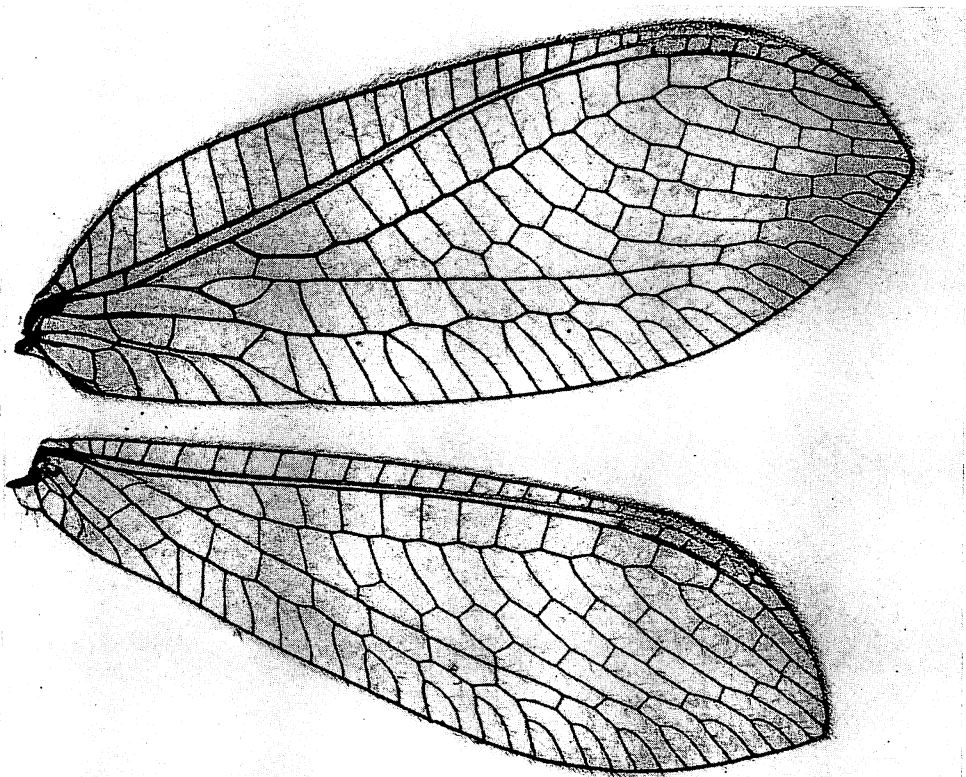


Figure 89—Wings of *Anomalochrysa viridis* Perkins, holotype male; Waimea, Kauai; fore wing length, 12.5 mm.

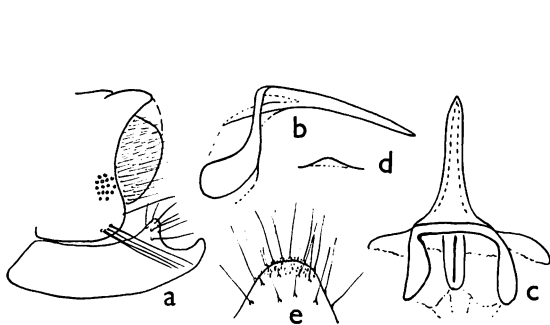


Figure 90

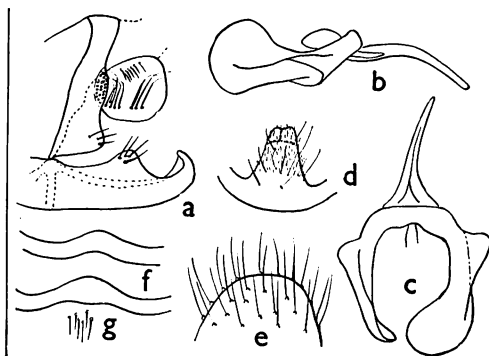


Figure 91

Figure 90—Male genitalia of the holotype of *Anomalochrysa sylvicola* Perkins. **a**, lateral view; **b**, **c**, lateral and dorsal views of tenth sternite and aedeagus; **d**, median sclerotization of subrectal sclerite; **e**, ventral view of apex of ninth sternite.

Figure 91—Male genitalia of the holotype of *Anomalochrysa viridis* Perkins. **a**, lateral view; **b**, **c**, lateral and dorsal views of tenth sternite and aedeagus; **d**, caudal, and **e**, ventral, views of apex of ninth sternite; **f**, **g**, variations in subrectal sclerite, that of the holotype at **g**. The number of setae on the dorso-caudal plate is variable.

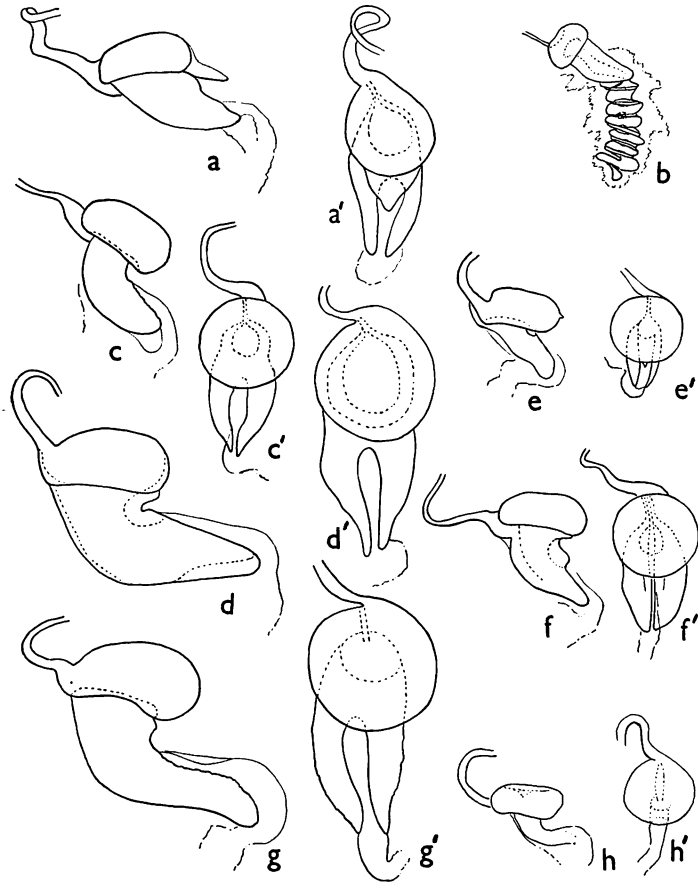


Figure 92—Spermathecae of *Anomalochrysa*, lateral and dorsal views. **a, a'**, *cognata* Perkins, Honolulu mountains, 1,800 feet; **b**, *frater* Perkins, paratype, Kona, Hawaii, 2,500 feet; **c, c'**, *fulvescens* Perkins, paratype, Haleakala, Maui, 5,000 feet; **d, d'**, *hepatica* McLachlan, Haleakala, Maui, 5,000 feet; **e, e'**, *haematura* Perkins, paratype, Koolau Range, Oahu, 3,000 feet; **f, f'**, *longipennis* Perkins, holotype, Kau, Hawaii, 4,000 feet; **g, g'**, *maclachlani* Blackburn, from a paratype of *deceptor* Perkins, Kau, Hawaii, 4,000 feet; **h, h'**, *molokaiensis* Perkins, holotype, Molokai mountains, 4,000 feet. All to same scale except **b** which is less enlarged.

***Anomalochrysa viridis*** Perkins (figs. 47; 53; 89; 93, i, i'; 95, h).

*Anomalochrysa viridis* Perkins, 1899:51, pl. 3, fig. 4. Zimmerman, 1940:493.

Endemic. Kauai (type locality: Waimea, 4,000 feet).

This species and *montana* may appear closely similar, but there are distinct differences in the two forms. The vestiture of the middle of the pronotum in *viridis* consists of inclined setae, but *montana* has long, erect, fine hairs. In *montana*, the ventral lobe of the male genitalia is short and does not project much beyond the lateral lobes. The chaetotaxy of the genitalia is also distinctive. As

noted in the key, the colors of the head and thorax also differ. The holotype, as the figure will show, has an abnormal number of forked cross-veins between  $Cu_1$  and the wing margin. This is a variable character.

This species is taken commonly in the highlands of Kauai. It is dark green in life, and the venation is often tinged with black.

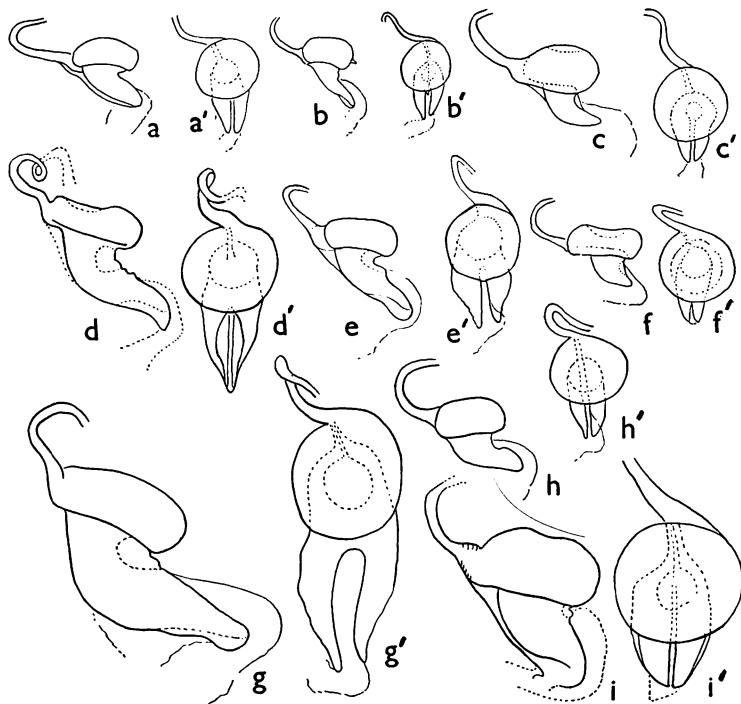


Figure 93—Spermathecae of *Anomalochrysa*, lateral and dorsal views. **a, a'**, *montana* Blackburn, Kau, Hawaii; **b, b'**, *debilis* Perkins (from the holotype of *nana*); **c, c'**, *princeps* Perkins, allotype, Kona, Hawaii, 3,000 feet, (although this species is one of the largest, the spermatheca is among the smallest examined; a similar situation occurs in *molokaiensis*); **d, d'**, *raphidioides* Perkins, paratype; **e, e'**, *rufescens* McLachlan, Honolulu; **f, f'**, *soror* Perkins, allotype, Haleakala, Maui, 5,000 feet; **g, g'**, *maclachlani simillima* (Perkins), allotype, Waimea, Kauai, 4,000 feet; **h, h'**, *sylvicola* Perkins, Makaleha, Oahu; **i, i'**, *viridis* Perkins, paratype, Waimea, Kauai, 4,000 feet. All to same scale except **d, d'**, which are less enlarged, and **i, i'**, which are more enlarged.

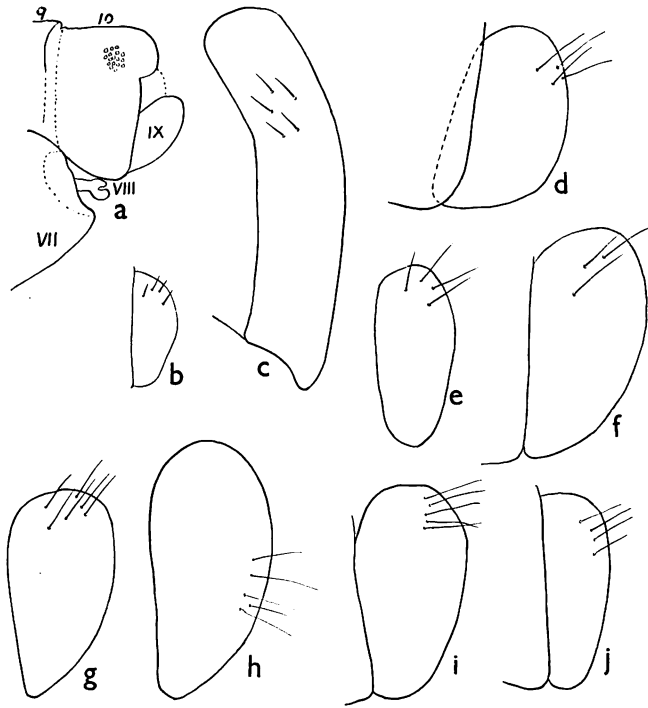


Figure 94—Characters of female genitalia of *Anomalochrysa*. **a**, lateral view of terminalia of *raphidioides* Perkins; **9**, **10**, tergites, **VII**, **VIII**, **IX**, sternites; the ninth sternite forms two valves, which may be called ovipositor valves for convenience. Figures **b**–**j** are the ovipositor valves of: **b**, *frater* Perkins, paratype from Kona, Hawaii, 2,500 feet; **c**, *cognata* Perkins, Honolulu mountains, 1,800 feet (the most unusual valve of any species examined; note the ventro-caudal angle and the short, anteriorly directed setae); **d**, *fulvescens* Perkins, paratype, Haleakala, Maui, 5,000 feet; **e**, *haematura* Perkins, paratype, Koolau Range, Oahu, 3,000 feet; **f**, *hepatica* McLachlan, Haleakala, 5,000 feet; **g**, *longipennis* Perkins, holotype; **h**, *maclachlani* Blackburn, from a paratype of *deceptor* Perkins, Kau, Hawaii, 4,000 feet; **i**, *molokaiensis* Perkins, holotype; **j**, *montana* Blackburn, Kau, Hawaii. All are to same scale except **a** and **b** which are less enlarged. Only a few setae are shown to indicate type.

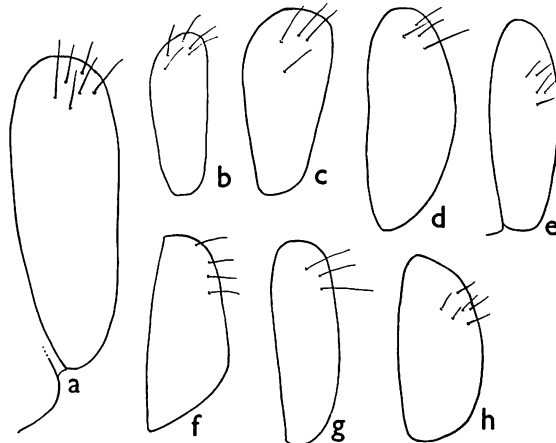


Figure 95—Tenth sternites (ovipositor lobes) of *Anomalochrysa*. **a**, *maclachlani similima* (Perkins), allotype, Waimea, Kauai, 4,000 feet; **b**, *debilis* (from the holotype of *nana* Perkins); **c**, *princeps* Perkins, allotype, Kona, Hawaii, 3,000 feet; **d**, *raphidioides* Perkins; **e**, *rufescens* McLachlan, Honolulu; **f**, *soror* Perkins, allotype, Haleakala, Maui, 5,000 feet; **g**, *sylvicola* Perkins, Oahu; **h**, *viridis* Perkins. All to same scale.

## Superfamily MYRMELEONTOIDEA Tillyard, 1926:321

We have in Hawaii only one of the five recognized families of this extensive group which Tillyard (1926:321) called "dominant within the Order." Only the Myrmeleontidae are represented here. The same is true in New Zealand, but Australia has the Nymphidae, Myiodactylidae, Ascalaphidae and Stilbopterygidae.

## Family MYRMELEONTIDAE Burmeister, 1829

*Myrmeleonidae* Stephens, 1836.

## Antlions

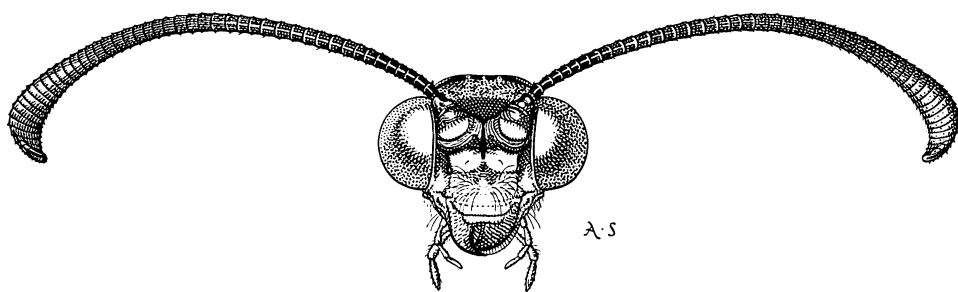


Figure 96—Frontal view of head of *Eidoleon wilsoni* (McLachlan), Pohakuloa, Hawaii.

Tillyard (1926:323) has pointed out that the spelling originally used by Burmeister is correct, because the genitive of the Greek *leon* is *leontos*, stem *leont-*, hence Myrmeleontidae, not Myrmeleonidae.

As recognized in this text, two possible species and a subspecies occur in Hawaii. These interesting creatures are very poorly known in our islands.

Only a few Myrmeleontidae have been found in Oceania, but Tillyard (1926) recorded 95 species in 36 genera in Australia (as compared with only two species in New Zealand). Many wonderful species live in Australia; some of them are giants with wing expanses of seven inches. Esben-Petersen (1928:91) listed only one species for Samoa. Several genera and a number of species occur in Europe, but none has become established in Great Britain. The family is represented in North America by about a dozen genera and many species. The family is best developed in warmer, arid and semiarid regions.

One cannot confuse these large neuropterons (as much as 90 mm. in expanse in our species) with any other insects in Hawaii, with the possible exception of the damsel flies. Even their slow flight is characteristic and can be recognized easily at a distance. Eyes large, prominent; ocelli absent. Antennae short, not much if any longer than head and thorax, strongly clavate. Fore and hind wings long and narrow, similar, with many accessory veins and cross-veins, radius with only one sector, veinlets between costa and subcosta not branched except in and beyond the pterostigma; hypostigmal cell elongated (the cell posterior to the

pterostigma between Sc and Rs; see Tillyard, 1915:747, fig. 6). Our species are somber in color; the wings are mostly hyaline but are marked with infuscations.

I have never seen a larva of an Hawaiian antlion, and nothing is known of the habits of our species (but see the note under *perjurus* and *wilsoni* below). Antlion larvae, which are known in America as "doodle bugs," are stout to rotund creatures with large, internally toothed, sickle-like mandibles. They characteristically lie hidden in sand, soil or debris. Their spherical, silken cocoons are covered with sand or debris. Some species make conical pits in sand or soil, at the bottoms of which they lie concealed in wait of prey. These are the characteristic antlions or "doodle bugs." When an insect tumbles into the pit, the larva quickly grasps it with its great jaws and sucks it dry. If the victim does not fall or slide quickly to the pit bottom, the larva may throw sand at it to knock it down within reach. It is fascinating to watch these extraordinary animals capture their prey, and I had much sport as a small boy in California "baiting" "doodle bugs." The pits are found in sheltered places such as under overhanging rocks, under the sides of logs and often in large numbers in the dry dust beneath buildings. Other species do not build pitfalls, but hide in sand, soil or debris and wait for prey to pass their way. Ants are said to form the principal food of many species, hence the name antlion.

It appears that the Hawaiian forms are derivatives from the widespread *Eidoleon bistrigatus* (Rambur) which ranges widely from Australia to Tahiti and neighboring islands.

#### Subfamily DENDROLEONTINAE

#### Tribe FORMICALEONTINI

#### Genus **EIDOLEON** Esben-Petersen, 1918:15

Type of the genus: *Formicaleo bistrigatus* Rambur, 1842.

The Hawaiian antlions are poorly understood, rarely collected and rest in our literature and collections in a confused state. In *Fauna Hawaiiensis* they were placed in *Formicaleo*. In my 1940 paper, I placed them in *Eidoleon*. In the determination of the species, however, I was led astray, because our series of specimens from Guam had been determined by a well-known authority on Neuroptera as "*Distoleon perjurus* (Walker)," whereas they are another species. They are different from any Hawaiian species, and I concluded that the original Beechey Expedition material, which had been described by Walker as *Myrmeleon perjurus* and stated to have come from Hawaii, had, like many other species taken by that expedition, been mislabeled. I have now had an opportunity to study the specimens taken on the Beechey Expedition (now in the British Museum), and it is obvious that I was misled and my 1940 conclusions were incorrect, because *perjurus* really was originally collected in Hawaii.

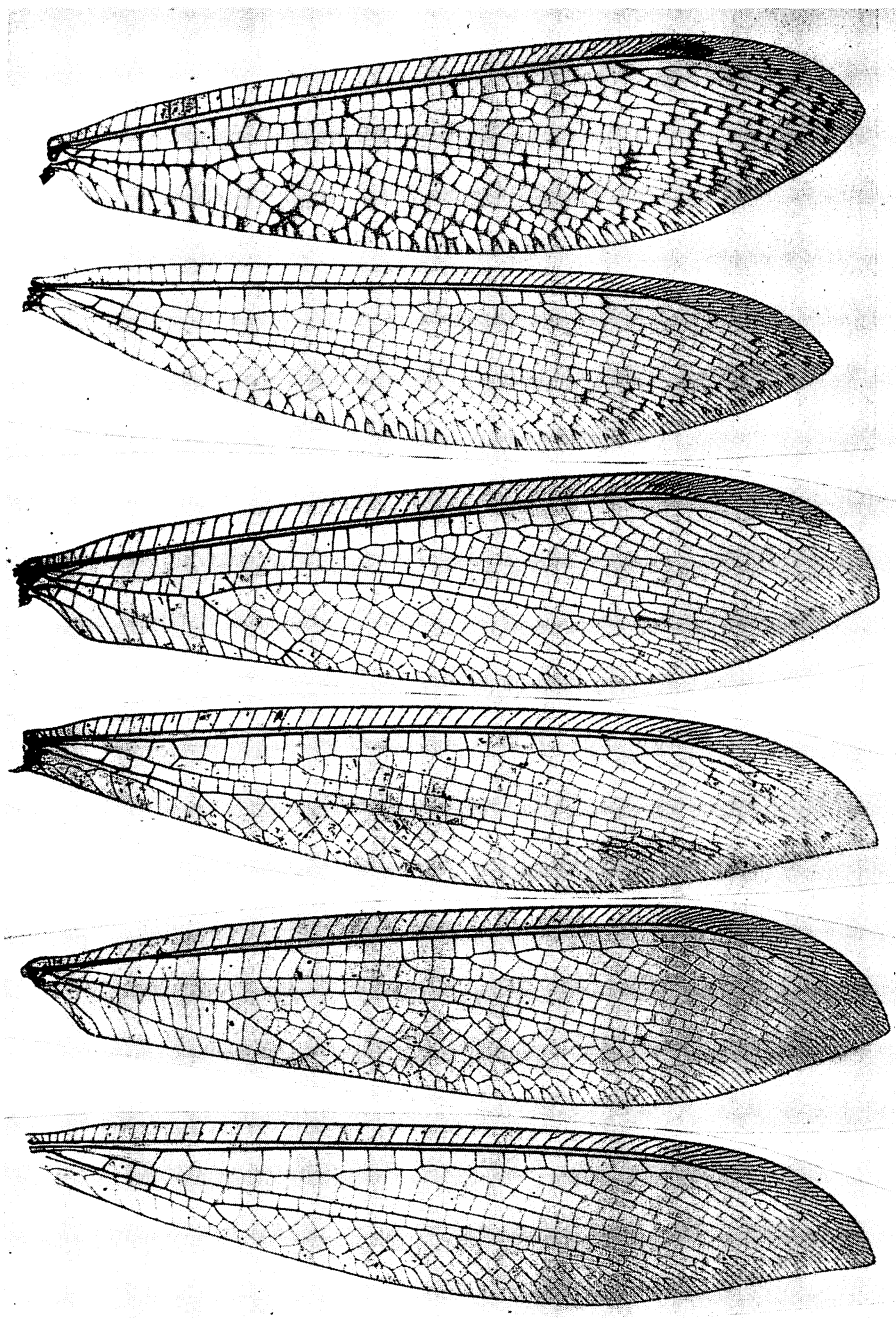


Figure 97—Wings of *Eidoleon*. Top: *wilsoni* (McLachlan), male; Kona, Hawaii, 4,000 feet; fore wing length, 45.5 mm. Middle: *perjurus perjurus* (Walker), male holotype; fore wing length, 36.5 mm. Bottom: *perjurus violentus* (Walker), holotype male; fore wing length, 30.5 mm. Not to same scale.

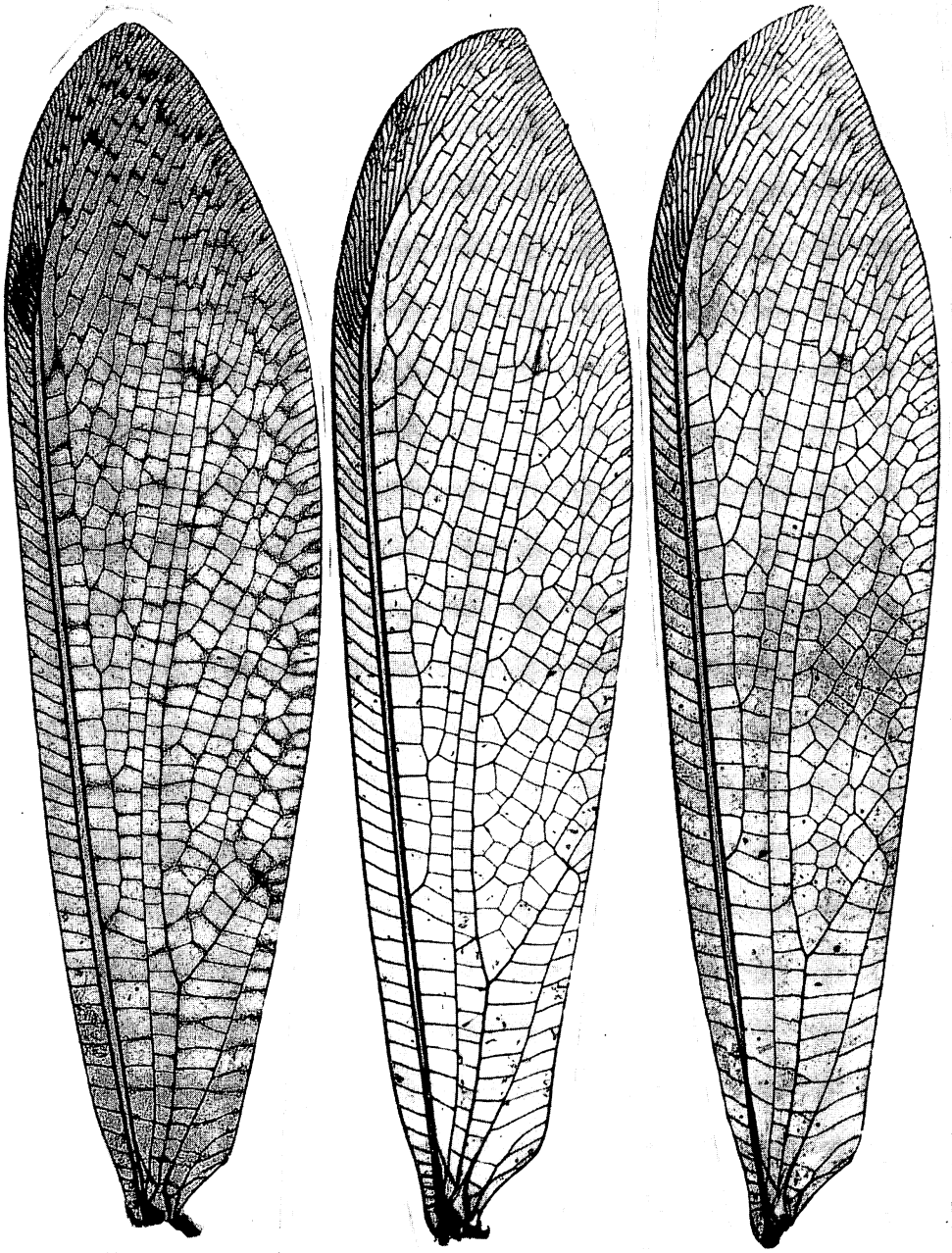


Figure 98—Fore wings of *Eidoleon*. Left: *wilsoni* (McLachlan), male, 45.5 mm., Kona, 4,000 feet. Middle: *perjurus perjurus* (Walker), holotype, male, 36.5 mm. Right: *perjurus violentus* (Walker), holotype, male, 30.5 mm. Not to same scale.



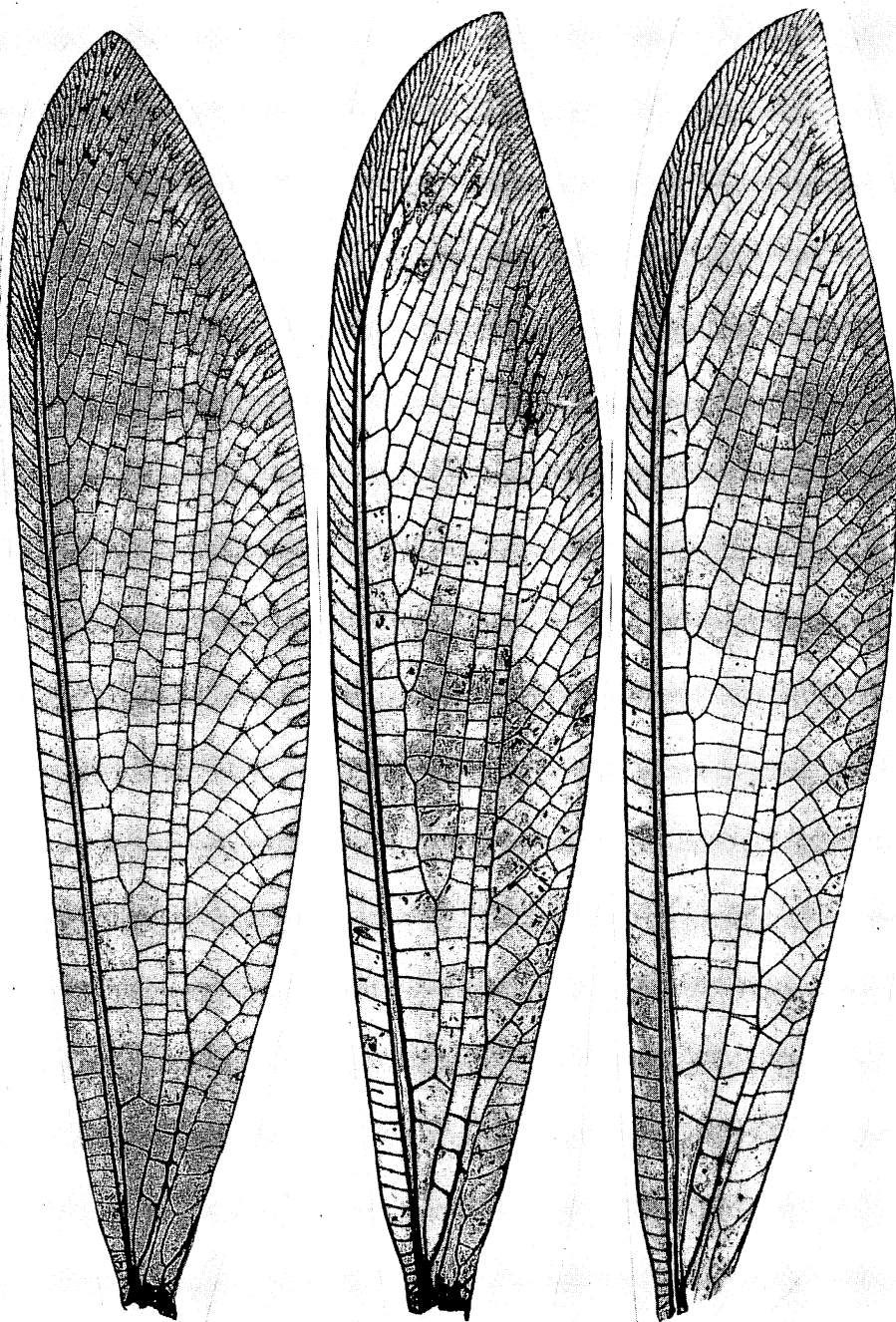


Figure 99—Hind wings of the *Eidoleon* in figure 98. Left: *wilsoni* (McLachlan), 45.5 mm. Middle: *perjurus perjurus* (Walker), 36 mm. Right: *perjurus violentus* (Walker), 30 mm. Not to same scale.

I have spent much time trying to understand the three named forms of Hawaiian antlions, but I must admit that I have not obtained satisfaction. The Hawaiian antlions appear to be in a state of plasticity and possible incipient speciation. If one studies the restricted series in the British Museum, it appears at first that there are two distinct species—*perjurus* and *wilsoni*—and a possible subspecies, *violentus*, of *perjurus*. However, further study of larger series has broken down almost every character that I have tried to use to separate the three forms. There are distinct differences in the venation of some examples, and these differences are so clear and obvious in some specimens that they would make excellent characters if they were stable, but they are highly variable. The shape of the wings seems to afford a good character, because the wings in the examples of *perjurus* and *violentus* which I have illustrated are somewhat falcate; but in the example of *wilsoni* illustrated, the wings are not falcate. This seemingly worthwhile character is worthless, however, because it blends from one specimen to another and from one extreme to the other. In the key I published in 1940, I used size to separate the forms, but I have since found that the size range is so great that it also is a worthless character, although all of the largest examples belong to *wilsoni*. A study of the genitalia of the males and females likewise has revealed variation and no specific differences. Typical *wilsoni* has conspicuously maculate fore wings, but there is much variation in the dark spotting. In spite of the instability of many of the characters, however, typical, large, dark *wilsoni* appear quite distinct from typical *perjurus*. There may be only one highly variable antlion in Hawaii, but pending further study of the problem, I shall tentatively consider that there are two species and one subspecies of antlions in our fauna which may be distinguished as follows:

#### KEY TO THE HAWAIIAN EIDOLEON

1. Most of the cells of the fore wings obviously infuscated along the cross-veins; hind wings without a dark, longitudinal streak; Lanai, Kahoolawe, Hawaii. . . . **wilsoni** (McLachlan).  
Fore wings without infuscations along the cross-veins, or at most with only a very few cross-veins infuscated; hind wing with or without a dark, longitudinal streak. . . . . 2
2. Hind wing with a longitudinal dark streak; Oahu, Maui, Lanai. . . . . **perjurus perjurus** (Walker).  
Hind wing without a longitudinal dark streak; Oahu, Molokai. . . . . **perjurus violentus** (Walker).

**Eidoleon perjurus perjurus** (Walker) (figs. 97; 98; 99), **new combination**.  
*Myrmeleon perjurus* Walker, 1853:340.  
*Formicaleo perjurus* (Walker) McLachlan, 1883:301. Perkins, 1899:61.  
*Eidoleon bistrigatus*, as a misidentification by Esben-Petersen, 1937:50. Zimmerman, 1940:489.

Endemic. Oahu (type locality: presumably Honolulu), Maui, Lanai.

On this form the cells of the fore wings lack, or very nearly lack, the infuscations which are so characteristic of *wilsoni*, and the hind wings have a dark, longitudinal streak.

Blackburn (1884:421) said: "It seems a singular thing that I have met with the one species of this family known as Hawaiian only in a single ravine on Maui, though there it is common, and so conspicuous as to seem incapable of escaping notice. It is fairly strong on the wing." McLachlan (1883:301) quotes Blackburn as follows: "Occurs sparingly in a ravine rising very abruptly from the sea-coast near Uoluolu, Maui."

Perkins (1913:clxxiii) said:

The two species of *Formicaleo* appear to be allied to one another, but to have rather different habits. *F. perjurus*, the smaller species, is, doubtless, much rarer than it formerly was, and has entirely disappeared from some of the localities, where it formerly occurred. I have never myself met with this insect, but I once found a solitary larva, which I suspect belonged to it, beneath a stone on the edge of the stream in Iao valley, Maui. It might almost have been said to be actually in the water.

Perkins' note on the supposed larva should be accepted with caution, because such a habit would be most unusual, if true. Perhaps, if the larva in question were actually an antlion larva, then it was in the damp place by accident.

There are two examples of this form in the British Museum. They are labeled "Sandw. I. Beechey."

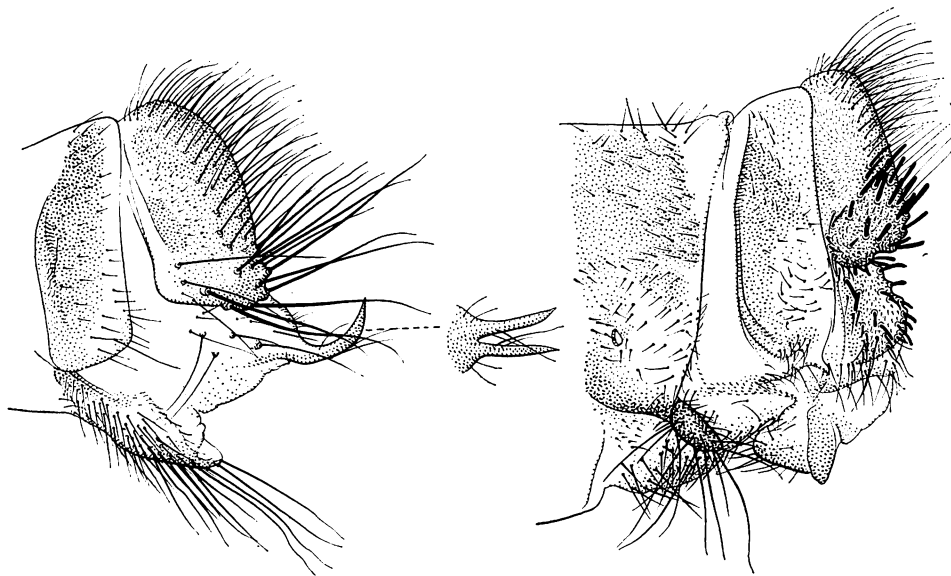


Figure 100—Lateral views of male (left) and female (right) terminalia of *Eidoleon wilsoni* (McLachlan). Both from Puu Kamaoa, Hawaii.

**Eidoleon perjurus** subspecies **violentus** (Walker) (figs. 97; 98; 99), **new combination.**

*Myrmeleon violentus* Walker, 1853:348.

*Formicaleo perjurus* variety *violentus* (Walker) McLachlan, 1883:301.

Endemic. Oahu (type locality: probably Honolulu), Molokai.

This is the pale, small form which lacks the fore wing infuscations as does typical *perjurus*, but it also lacks the dark, longitudinal streak in the hind wings which is present on typical *perjurus*. Esben-Petersen (1937:50) listed this as a synonym of *bistrigatus*.

There are five specimens of this form in the British Museum, and they are labeled "Sandw. I. Beechey." They are all damaged and mostly in poor condition.

**Eidoleon wilsoni** (McLachlan) (figs. 96; 97; 98; 99; 100).

*Formicaleo wilsoni* McLachlan, 1892:178. Perkins, 1899:62. Esben-Petersen, 1937:50.

*Formicaleo ballievi* Navas, 1914:475; synonymy suggested by Esben-Petersen, 1928:91.

*Eidoleon wilsoni* (McLachlan) Zimmerman, 1940:488.

Endemic. Lanai (type locality), Kahoolawe, Hawaii.

This form lacks the dark streak in the hind wings, but the fore wings have most of the cells conspicuously infuscated along the cross-veins. Although there is much overlapping in size in the three forms, *wilsoni* produces more larger specimens; some may have an expanse of 90 mm.

The larger ant-lion, *F. wilsoni*, is a common insect on the driest lava-fields of Hawaii, where there is a scanty vegetation or the surface is barren. It occurs near the coast as well as at elevation from 4000-6000 ft. above the sea. It is readily disturbed, as one walks along in such localities, by day, usually settling down again after no very long flight. We have seen it taking more extensive and higher flights at nightfall. The habits of the larva are not known, but probably it lives beneath stones or in cavities of the porous lava, as no burrows have been noticed where the species is common. It cannot prey on ants, for these do not exist in the uplands, where the ant-lion abounds. Some of its haunts are so barren that one may well wonder what insects are numerous enough to support the many larvae that must occur. (Perkins, 1913:clxxiii.)

Beardsley (*Proc. Hawaiian Ent. Soc.* 15(3):384, 1955) reports finding cocoons under stones on Hawaii.

The British Museum series consists of the type from Lanai and five of the Perkins' specimens from Kona, Hawaii.

## Superfamily CONIOPTERYGOIDEA Tillyard, 1926:320

This superfamily contains only one family.

## Family CONIOPTERYGIDAE Burmeister, 1839

## Coniopterygids, Mealywings

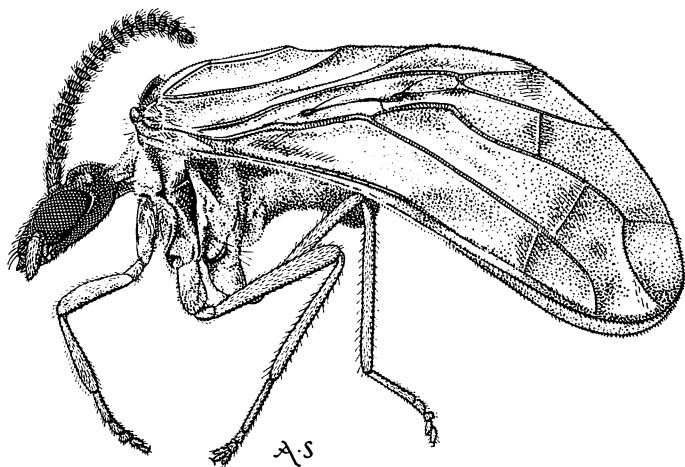


Figure 101—*Coniocompsa zimmermani* Kimmins; Waialua, Oahu; length, 2.5 mm.

The smallest and most divergent of the Neuroptera belong here. The simplified wing venation is far removed from the general type found throughout the order, and, at first glance, it vaguely resembles that of some psocids or even some Diptera. Persons unfamiliar with these delicate little insects frequently have difficulty placing them in an order, and their true position in relation to other insects remained unsettled for a long time. Müller described the first species in 1767, and he properly associated it with the Hemerobiidae. Some workers have placed these insects in association with aleyrodids, psocids and trichopterans. It remained for Westwood (1840:49) to set forth positively the true relationships of the family. The body and wings are dusted with a white or grayish, mealy or powdery wax, and this gives some species an almost aleyrodid-like appearance. Some are occasionally mistaken for psocids or even psychodid flies. There are only about 12 genera and less than 100 species known in the world, but the family is little studied and poorly known. Two species have become accidentally introduced and established in Hawaii. Tillyard recorded 12 species in Australia and one in New Zealand in 1926. Killington listed five genera and seven species in Britain in 1936. Fossil Oligocene species are known.

Eyes moderate; ocelli absent. Antennae moderate to long, moniliform, about 16- to over 40-segmented. Fore and hind wings of rather similar type, but hind wings smaller, venation reduced, greatly simplified, accessory veins absent and

cross-veins few, radius with only one two-branched sector, veins lacking distal forkings (some species brachypterous, see Kimmins (1950:166) for example). Our species range in size from about 4 to 5 mm., and they are of a general grayish or white color.

The ovate eggs are somewhat dorso-ventrally flattened, the micropyle is protuberant and acutely pointed, and the surface is beautifully, reticulately sculptured. The eggs are often deposited singly, or in groups of a few, along the edges of leaves or along the edges of protuberant veins of leaves. The embryos are equipped with characteristically shaped egg-bursters.

The spindle-shaped, slightly depressed larvae are widest in the meso-metathoracic region and taper rapidly caudad. The integument is smooth, but there are some transverse rows of fine setae on the segments. Head small, partly retracted in prothorax; five facets in each eye; antennae two-segmented, first segment small, second long, beset with long hairs, thus appearing plumose; the conical mouthparts concealed from above in most species by the pointed, protuberant labrum, mandibles narrowly-elongate-conical, nearly straight, sharply pointed, labial palpi three-segmented with the third segment considerably enlarged, clavate, and held conspicuously out in front of the head. Thorax large, constituting about half the body, prothorax largest; legs with the tibio-tarsal articulation not very free, tarsi with two claws, empodium small and pad-like. Abdomen 10-segmented, sharply tapering, caudal segment adhesive.

The cocoon in some species is unusual, because it may be made in two parts, one spun inside the other—a cocoon-within-a-cocoon arrangement. It is usually a circular, flat, double envelope of silk fastened to a leaf or to bark.

Withycombe, who has made such excellent contributions to our knowledge of the biology and anatomy of the Neuroptera, unfortunately did not report fully upon the anatomy of the Coniopterygidae which, he wrote in 1923, “. . . in many respects differs in detail from general Neuropterous type.” He did note, however, that “In the larva, of the six Malpighian tubes, four are attached distally and two are free. The silk secreting cells swell, but apparently do not exhibit a ramified nucleus. Another feature of the Coniopterygidae is the great reduction in size and number of the abdominal nerve ganglia by concentration. Frequently there are no more than three, of which the last consists of several fused ganglia.” (1923: 577.) It should be noted that there are only six Malpighian tubes in this family, whereas there are eight in other neuropterous families.

When the adult emerges from its cocoon, it is not clothed with wax, but its wax glands soon begin to function. The newly emerged insect then distributes the wax over its wings and body with the aid of its legs. Withycombe had the following to report upon wax production (1923:578):

The wax glands of the imago . . . are unicellular dermal glands, arranged in definite areas of the body. Their presence is revealed externally by small perforations in the integument. Through the perforations wax is forced and takes the form of circles and short spirals. Wax-gland areas are mainly situated on the abdomen, there being a pair dorso-laterally and another pair ventro-laterally [on most abdominal segments]. Other areas occur on the dorsal surface of head and thorax, besides minor patches occasionally at the base of the wings and elsewhere.

These insects are very active in their search for prey, which consists of such organisms as Acarina, psocids, aphids, diaspine coccids, etc., as well as the eggs of insects and mites.

The two species now established in Hawaii have thus far been reported from the more arid areas. Most examples have been taken at lights. Some specimens have been swept from *Euphorbia* and native cotton, but, unfortunately, that is about all we know about them in Hawaii.

#### KEY TO THE SUBFAMILIES

1. Cubitus in hind wing running parallel to and nearly touching media for more than half its length, at most not separated by much more than the thickness of a vein; galea with three segments. . . . . **Aleuropteryginae.**
2. Cubitus in hind wing well separated from media; galea with one segment. . . . . **Coniopteryginae.**

#### Subfamily ALEUROPTERYGINAE Enderlein, 1905:225

The species of this subfamily have the galea three-segmented (resembling palpi), cubitus is very close or nearly fused with media for more than half its length in the hind wings, and abdominal segments one to six have peculiar, ventro-lateral organs (below the level of the spiracles) which may be called saclets (Ventralsuchchen of Enderlein), and which might be confused with spiracles upon superficial examination.

#### Tribe CONIOCOMPSINI Enderlein, 1905:225

In the fore wings  $R_{4+5}$  is of normal form and arises as a definite branch of  $R_s$  well isolated from  $M$ . In the other tribe of this subfamily, the Aleuropterygini,  $R_{4+5}$  is so connected to  $M$  that it appears to be a branch of that vein instead of a fork of  $R_s$ . (See figure 102.)

#### Genus CONIOCOMPSA Enderlein, 1905:225

**Coniocompsa zimmermani** Kimmins (figs. 101;102, a, b, c).

*Coniocompsa zimmermani* Kimmins, 1953:37, figs. 1, 2, 3.

Oahu (type locality: flats west of Makapuu Head), Maui.

Immigrant. Source undetermined, but allied to such species as *vesiculigera* Enderlein from the Malay Peninsula, *japonica* Enderlein and *indica* Withycombe. First taken in Hawaii by Swezey, who collected the first specimens at light at Kaimuki, Honolulu, in 1914.

Hostplants: Swezey has taken it on *Euphorbia*, and I have swept specimens from native cotton, *Gossypium tomentosum*.

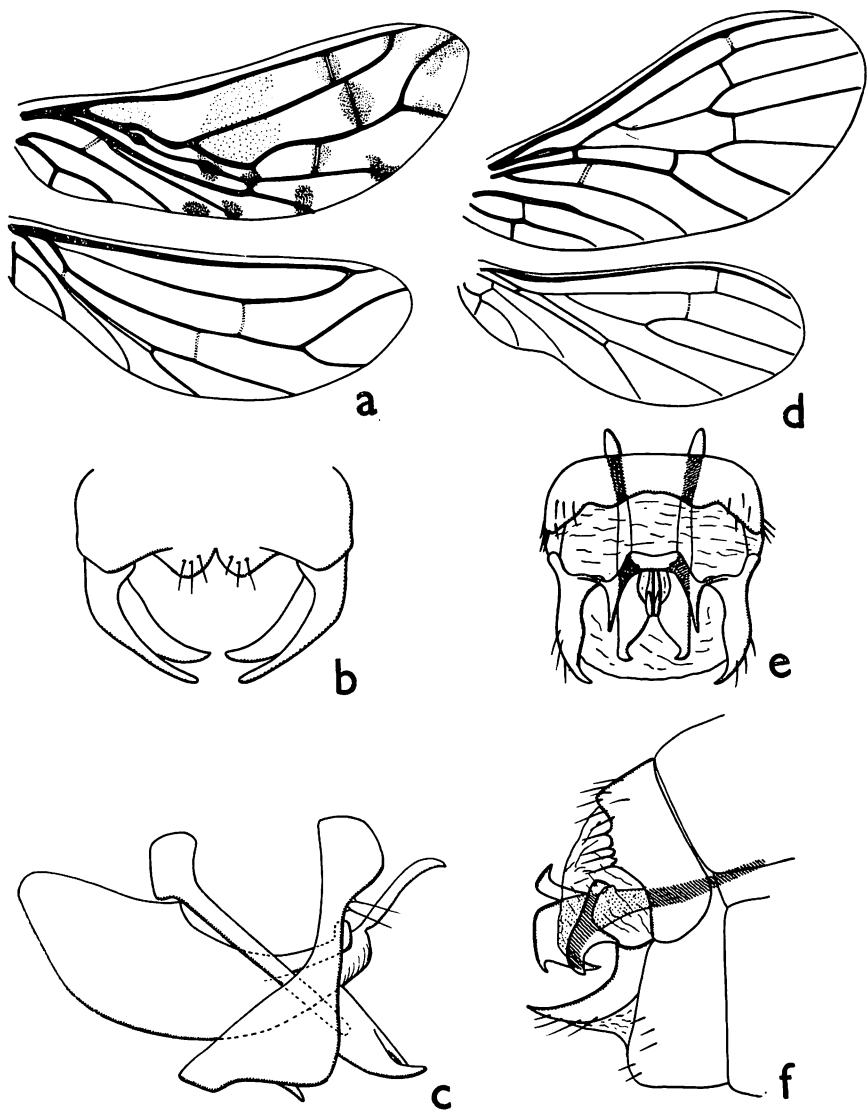


Figure 102—Details of Coniopterygidae. a-c, *Coniocompsa zimmermani* Kimmins: a, wings; b, c, ventral and lateral views of part of male genitalia. d-f, *Coniopteryx pembedtoni* Kimmins: d, wings; e, f, ventral and lateral views of male genitalia. (After Kimmins.)



This species has been found in the arid country from the Makapuu Head—Koko Head area, Kaimuki and lower Manoa in Honolulu, and the Ewa area on Oahu. The largest series of specimens I have seen have been from numerous light-trap catches made on Ewa Plantation.

For many years this species has been recorded in Hawaiian literature under the name *Coniocompsa vesiculigera* Enderlein, 1906:224 (the genotype). When I came to write this chapter, I found that obviously it was not that species, as a comparison with Enderlein's text and illustration of the wing will quickly reveal, and Mr. Kimmins kindly described this and the following species.

In the field this species can be separated at a glance from *Coniopteryx pembedtoni*, the other species found in Hawaii, because *zimmermani* has white wings marked with brown spots, whereas *pembedtoni* is a grayish species.

#### Subfamily CONIOPTERYGINAE Enderlein, 1905:225

Enderlein included in this group those species which have the galea one-segmented, hind wings with cubitus and media well separated, often diverging from the base, and the sides of the abdomen without "saclets" below the spiracles.

#### Tribe CONIOPTERYGINI Enderlein, 1905:226

This group is separated from the other tribe of the Coniopteryginae, the Conwentziini, because in the Coniopterygini the hind wings are normally developed instead of being much reduced in size.

#### Genus CONIOPTERYX Curtis, 1834

This genus has representatives in most faunal regions, but it is possibly artificially composite.

**Coniopteryx pembedtoni** Kimmins (fig. 102, d, e, f).

*Coniopteryx pembedtoni* Kimmins, 1953:37, figs. 4, 5, 6.

Oahu (type locality: Ewa).

Immigrant. Source undetermined, but western Pacific. The first examples of this species found in Hawaii were discovered by C. E. Pemberton in 1951 in catches made at a light trap at Ewa, near Honolulu.

This small gray species is easily separated from our *Coniocompsa* because of its grayish, unspotted wings alone.

Kimmins considers the species to belong in association with *ralumensis* Enderlein from the Bismark Archipelago, *javanica* Enderlein, and, most closely, to *maculithorax* Enderlein from Australia. In all probability it was introduced on war material imported to Pearl Harbor.

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## Order **TRICHOPTERA** Kirby, 1913

(*trichos*, hair; *ptera*, wings)

### Caddisflies

This order of almost entirely aquatic insects is not represented in our native fauna, but a small, foreign species has been imported accidentally and is now established here.

Hairy, usually somber-colored insects, some closely resembling moths. Head hypognathous, often rough-haired; compound eyes widely separated; three ocelli present, or ocelli absent; mandibles absent or vestigial; maxillary palpi usually five-segmented, but reduced to two, or three or four segments in the males of some species; labial palpi three-segmented; ligula small or wanting; hypopharynx usually well-developed; antennae multisegmented, filiform, often very long, often held together and directed forward in front of the head when at rest. Thorax with a short prothorax bearing small patagia; mesothorax larger than the pro- or metathorax, with small tegulae. Legs long, well formed for running; tibiae usually with spines and movable spurs; tarsi five-segmented, a pair of pulvilli or an empodium present between the paired claws. Wings four in number and usually well developed (some forms have one or both pairs of wings reduced), usually densely clothed with hair, and usually held roof-like over the body when at rest; some forms have rather primitive scales scattered amongst the hair; fore wings usually of thicker texture than hind wings, coriaceous in some species; hind wings usually broader than fore wings; fore and hind wings held together in flight either by a row of small costal hooks on the hind wings or a development of the jugal lobe in the fore wing, or a long fold along the posterior margin of the fore wing; venation of a rather simple and generalized type, approaching that of the Lepidoptera, most veins longitudinal and cross-veins few; in the crotch where M forks in both pairs of wings a small glandular (?) spot or organ, free from hairs, and known as the *thyridium*, is usually present (absent in Hydroptilidae). Abdomen 10-segmented; spiracles present on segments one to seven; male genitalia approaching the Lepidoptera in form, and with numerous homologous organs and arrangements; females of some species with a retractile, simple ovipositor.

Metamorphosis complete. Eggs of most species laid in groups in a gelatinous matrix which is attached to various objects, usually under water. The form of the egg mass is often specifically distinctive. The larvae are fitted with strong, biting mandibles and have well-developed legs and an anal pair of abdominal prolegs; gill tufts present or absent; mostly herbivores, but many carnivores. One of the characteristics of the order is the case-building habit of the larvae of many species. The cases are of many types and shapes and are often useful in ascertaining the identity of the species. They are carried by the larva much as a hermit crab carries the shell in which it lives. The cases range from simple tubes to elaborate coiled

structures, which are sometimes mistaken for snail shells. The cases are built upon a foundation of silk (spun from oral spinnerets) to which is fastened all sorts of objects such as mud, sand, leaves, bits of leaves, small sticks, fragments of bark, seeds, mollusk shells, etc. Some larvae do not construct cases, but they build silk-lined, fixed structures. Others construct under-water nets of silk in which their prey is trapped. Pupation occurs in the water, and the pupa is fitted with strong mandibles to enable it to bite its way out of its case. The adults take no solid food; some species appear not to eat as adults, but others are known to take fluid nourishment, such as nectar. The student is referred to the standard texts for detailed accounts of these interesting animals.

The larvae form one of the dominant sources of food for trout and certain other fresh-water fishes. Some species are considered valuable in aiding restriction of growth of certain water plants and algae. Some species emerge in great swarms, which may create a nuisance when they are attracted to lights. Not all species inhabit fresh water; some are known to live in brackish water and some are reported to live in salt water and the genus *Enoicyla* has terrestrial larvae and pupae.

The Trichoptera are closely allied to the Lepidoptera, and some species are not infrequently confused with the Lepidoptera and considered small moths. The Trichoptera have few or no scales and no broad ones of the lepidopterous type. There is no coiled proboscis such as is found in most Lepidoptera.

The number of species known in the world approximates 4,000. None arrived in Hawaii by natural means, and the order is absent from Polynesia east of Samoa. In Samoa there are several species, quite a development occurs in Fiji, and from there west the order is well developed. In 1926, Tillyard recorded 58 species in 10 families in Australia and 47 species in 6 families in New Zealand. The order is well developed on all the continents. Fossil caddisflies are numerous in some Tertiary fossiliferous strata, and evidently the order can be traced back to ancestors in the Upper Permian. There are about 15 families recognized in the order, but we have only the one following represented in Hawaii.

#### Family HYDROPTILIDAE Stephens, 1836

##### The micro-caddisflies

These are the smallest members of the Trichoptera; they closely resemble small tineoid moths, and it takes close inspection of our representative to separate it from the Lepidoptera. The hairy wings, absence of scales, drooping palpi and absence of a proboscis are characters which will serve to separate it from the moths. Both sexes have five-segmented maxillary palpi; wings very narrow, usually folded flat over the abdomen when at rest, venation reduced or compressed, hind wings with long fringes, fore wings with some rough groups of erect hairs distad. Some of the known larvae build flat, seed-like cases open at both ends and much larger than the larva, which can turn around within the case. The posterior part of the abdomen of the mature larva is greatly enlarged. The larvae feed upon algae. Some are unique among known caddisfly larvae because they have a type of hyper-

metamorphosis. The first-stage larvae of some species are free-living, slender forms, but after a period of time they settle down, build cases and change considerably in appearance.

Genus **OXYETHIRA** Eaton, 1873

**Oxyethira maya** Denning (figs. 103; 104).

*Oxyethira maya* Denning, 1947:16, figs. 4, 4a, 4b.

Oahu.

Immigrant. The first Hawaiian specimens were collected by me at Moanalua Gardens, Honolulu, in October, 1940 (Zimmerman, 1943: 350). Later, it was described from a single example found in Macon, Georgia (Denning, 1947).

The determination of our species was made by H. H. Ross who stated (1948: 257), "The adults of this genus are straw color and about 3 mm. long. The aquatic larvae construct a flat, silken purse-case which is not easy to detect, and is frequently attached to plants."

A note by Miss C. Inada (*Proc. Hawaiian Ent. Soc.* 13(3): 323, 1949) that the larvae of a second species of Trichoptera were collected at Moanalua Gardens in 1947 needs verification. I have not collected the larvae of *Oxyethira maya*, and it is possible that the larvae reported by Miss Inada actually belong to this species.

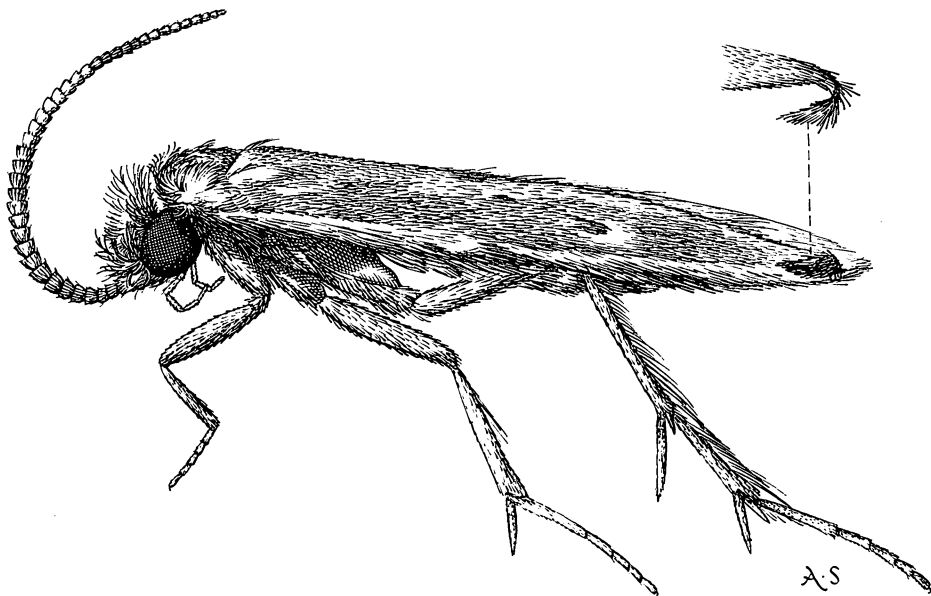


Figure 103—*Oxyethira maya* Denning, male, 3 mm.; Waipio, Oahu.



The following characters will make possible the recognition of this small member of our list of immigrant insects: It greatly resembles a small tineoid moth, but lacks a proboscis and has hairs instead of scales. Palpi long, conspicuous, pendant, segments distinct; maxillary pair five-segmented, labial pair three-segmented. Body densely hairy; hairs on the posterior edges of the wings longer than the breadths of the slender, elongate-lanceolate wings; numerous hairs on the dorsum of each wing erect and giving a rough, shaggy appearance; hairs on the head arranged in great bristling tufts; ground color of wings iridescent white, but marked with some fuscous areas. Wing-spread about 5 mm.

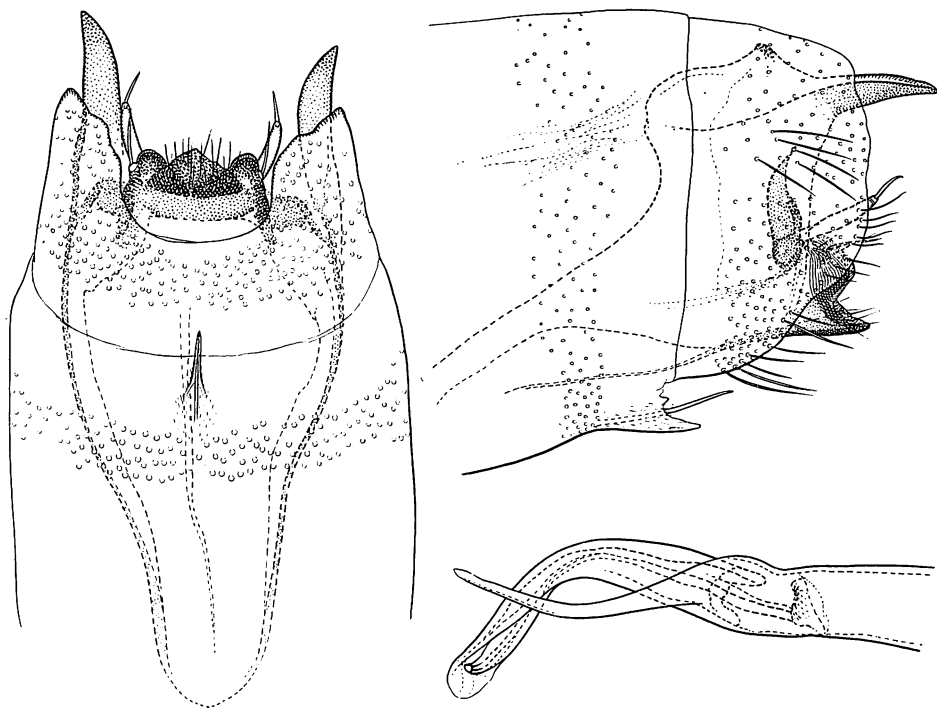


Figure 104—*Oxyethira maya* Denning, male genitalia; ventral and lateral views and aedeagus.

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## SUPPLEMENT TO VOLUMES ONE TO FIVE

It is now more than seven years since the first volumes of this series were published, and it is time to publish lists of corrections and additions. In the preface to the first five volumes (Vol. 1, p. x), I said, "I plan, tentatively, to publish each year a supplemental paper in the *Proceedings of the Hawaiian Entomological Society* in which notes, corrections and certain additions will be incorporated—or perhaps someone else will undertake the task or carry on after me." That plan has failed, and, now that I am no longer a resident of Hawaii, it is improbable that regular supplements to *Insects of Hawaii* will be prepared as had been hoped.

Since the first five volumes were published, 38 additional species have been added to the groups covered by those volumes (up to the time this manuscript was closed in the autumn of 1955).

In the following pages I have prepared lists of corrections and additions to the first five volumes. This material is arranged volume by volume and page by page, and it is suggested that notes referring to the following data be entered in the appropriate places in the first five volumes.

### CORRECTIONS AND ADDITIONS TO THE FIRST FIVE VOLUMES

#### VOLUME I: INTRODUCTION

- p. 74, line 8, for "two" read "three" and add *Pseudocymus* after *Sephora*.
- p. 78, after "8 Caloptilidae" add "*Philodoria*, 14 species and."
- p. 79, after "17" read "3" instead of "2."
- line 6, under "19" remove "endemic" after *Hypenodes*.
- p. 93, at *Paractopa* in the Lepidoptera, add "*Philodoria* 14 species."
- p. 124, end of line 3 in figure legend, add "*Amastra* (*Heteramastra*) *hutchinsonii* (Pease)."
- p. 157, line 6, read "four" for "five."
- p. 158, paragraph 4, line 1, read "must" for "much."
- p. 189, under the Van Dyke entry, read "89-129" in place of "1-129."
- p. 205, remove "Variation, 52."

#### VOLUME II: APTERYGOTA TO THYSANOPTERA

##### COLLEMBOLA

- p. 47, add "Börner, 1901" after "Family Achorutidae."
- p. 56, add Marquesas to distribution of *Isotoma minor*.
- n. 58, add North America, Marquesas, Society Islands to distribution of *Sinella caeca*.

- add Eurasia to distribution of *Sira jacobsoni*.
- p. 59, add Marquesas and Society Islands to distribution of *Entomobrya lactea*, and to *Entomobrya multifasciata imminuta*.
- p. 61, add Folsom, 1932:68, to *Lepidocyrtus heterophthalmus* references.
- p. 62, add Carpenter, 1934:373, to *Lepidocyrtus inornatus* references and add Marquesas to distribution.
- p. 63, add Carpenter 1934:140, to the *Salina maculata* references and Tahiti to the distribution.
- p. 64, add Malaya to the distribution of *Cyphoderus assimilis*.
- p. 69, add to bibliography: HANDSHIN, EDWARD. 1938. CHECK LIST OF THE COLLEMBOLA OF OCEANIA. Ent. Monthly Mag. 74:137-147.

## ORTHOPTERA

## BLATTIDAE

- p. 79, line 6, read "hyperparasite" for "hypoparasite."
- p. 80, paragraph 4, read "cucaracha" for "cucuracha."
- p. 85, add *Rhipidius pectinicornis* Thunberg (Coleoptera: Rhipiphoridae) as a parasite of *Blatella lituricollis*.
- p. 88, line 18, read "population of *Supella*" for "population of *Symptloce*."
- p. 94, add Niihau to localities of *Pycnoscelus surinamensis*.
- p. 95, Schwabe (*Proc. Hawaiian Ent. Soc.* 13(3):433-436, 1949) has published an account of the life history of *Pycnoscelus surinamensis*, and in 1950 (*Proc. Hawaiian Ent. Soc.* 14(1):175-183) he published methods of control in relation to eyeworm in poultry.
- p. 96, add Niihau to locality records of *Diploptera dytiscoides*.

## MANTIDAE

- p. 102, add:

**Tenodera australasiae** (Leach)

*Mantis Australasiae* Leach, *The Zoological Miscellany* 1:78, pl. 34, 1814.

Oahu.

Immigrant. Australia, Tasmania, New Zealand, New Guinea, Ternate, Ceram. First collected in Hawaii at Barber's Point Naval Air Station, by Ford in 1950.

Pemberton figures the oothecae of this species and of *angustipennis* (*Proc. Hawaiian Ent. Soc.* 14(3):367, 1952).

## ACRIDIDAE

- p. 104, add Niihau to localities of *Atractomorpha ambigua*.
- p. 105, after "Parasites" read *Tachysphex "fusus" for "fuscus."*

## TETTIGONIIDAE

- p. 121, add Niihau to list of localities of *Conocephalus saltator*.
- p. 122, after "Hosts," add *Omiodes accepta* (Butler).

## GRYLLIDAE

- p. 143, add Niihau, Maui and Hawaii to localities of *Metioche vittaticollis*. For notes, see F. X. Williams, *Proc. Hawaiian Ent. Soc.* 13(1):29-30, 1947.

## ISOPTERA

- p. 164, after "5(4)" of key, for first two lines read "Third antennal segment *as long* or longer than following two combined; pronotum three-fourths *as long along median line as breadth*, its . . ." and "Third antennal segment only about one-fourth longer than fourth, *or at least shorter than four plus five*; pronotum less than one-half *as long along median line as breadth*, its . . ."
- p. 165, add Midway and Niihau to localities of *Cryptotermes brevis*.
- p. 169, add *Kalotermes curvithorax* Kelsey (*New Zealand Jour. Sci. and Tech.* 25(B):45-53, 3 figs., 1943), described from driftwood on Canton Island, to synonymy of *Kalotermes immigrans* (see Van Zwaluwenburg, *Proc. Hawaiian Ent. Soc.* 14(3):351, 1952); add *Leucaena glauca* to hostplants.
- p. 172, add South Africa to distribution and *Coptotermes remotus* Silvestri *Boll. Lab. Zool. Gen. Agr. Portici* 21:93, fig. 2, 1928, to synonymy.
- p. 177, add to recommendations for the prevention and control of damage by *Coptotermes formosanus*: C. B. Keck, "The elimination of subterranean termite damage by structural methods." *Proc. Hawaiian Ent. Soc.* 15(1):187-194, figs. 1-4, 1953.

## EMBIOPTERA

- p. 195, add:

**Oligotoma (Aposthonia) oceania** Ross.

*Oligotoma (Aposthonia) oceania* Ross, *Proc. Hawaiian Ent. Soc.* 14(2):307-310, fig. 1, 1951.

Oahu, Nihoa, Laysan.

Immigrant. Known also from the Marquesas, Henderson Island, Rapa, Austral Islands, Society Islands and Fanning Island. Previously misidentified in literature under the names *Oligotoma vosceleri* (Krauss) and *insularis* McLachlan.

## DERMAPTERA

- p. 200, see Marucci, *Proc. Hawaiian Ent. Soc.* 15(3):565-569, 1955, for life history notes. *Anisolabis eteronoma* feeds on larvae of *Dacus dorsalis* Hendel.
- p. 203, add Niihau to localities of *Labidura riparia*.
- p. 206, Marucci (*Proc. Hawaiian Ent. Soc.* 1952:349; 1955:565-569) reported that *Sphingolabis hawaiiensis* is ovoviviparous, evidently a new record in non-parasitic earwigs. See the latter reference for much interesting biological data. The species feeds on the larvae of the fruit fly *Dacus dorsalis* Hendel.
- p. 212, under Lucas, insert "Bull. in" before "Ann." and "(2)5:" after "France."

## CORRODENTIA

- p. 230, Mr. J. V. Pearman has informed me that *Psylloneura williamsi* belongs to *Tapinella* Enderlein, 1908, and may prove to be the same as *formosana*.
- p. 232, under *Caecilius analis*, add "Parasite: *Alaptus globosicornis* Girault (Hymenoptera: Mymaridae)."
- p. 236, in figure legend, read "psocid" for "psyllid."
- p. 244, paragraph two under Psocidae, first line, delete "described 14 species, none of which was figured" and read "described a species under *Stenopsocus*, but his species does not belong."
- p. 250, bottom of page. Mr. J. V. Pearman has studied the type of (*Stenopsocus?*) *pulchripennis* Perkins and informs me that this belongs to *Propsocus*, and that *Myopsocus nitens* Hickman, 1933, from Tasmania, is a synonym.

## MALLOPHAGA

- p. 255, in key after "2," read "setiform" for "seriform."  
 p. 269, in dichotomy "3(2)" in key, reverse 4 and 7.

## ANOPLURA

- p. 299, add Niihau to localities of *Haematopinus suis*.  
 p. 319, under Thompson, 1938-1939, insert "75:" after "1938."

## ODONATA

- p. 321, line 3 from bottom. Col. F. C. Fraser has informed me that the Indo-Pacific region has proved to be richer in Odonata than the Neotropical region.  
 p. 357, McLachlan is the author of *calliphya*, not Perkins as stated in dichotomy 10(8).  
 p. 381, add Niihau to the distribution of *Enallagma civile*, and add *Microvelia vagans* White as a host.  
 p. 383, line 3, read "1896-97."

## THYSANOPTERA

- p. 393, second line of figure legend, read "*Cephalothrips errans* Moulton" for "*Hoplothrips flavipes* (Bagnall)."  
 p. 396, *Aeolothrips fasciatus* has also been found on grasses and ferns.  
 p. 399, add *Broussaisia* and taro to hostplants of *Heliothrips haemorrhoidalis*.  
 ——— add Lanai to localities and *Heliotropium curassavicum* to list of hostplants of *Hercothrips fasciatus*.  
 p. 400, add Hawaii to localities of *Dendrothripoides ipomeae*.  
 p. 401, *Scirtothrips antennatus* belongs to *Asprothrips*, according to J. C. Crawford.  
 p. 402, in figure legend read "*Cephalothrips errans* Moulton" for "*Hoplothrips flavipes* (Bagnall)."  
 p. 404, add Maui to localities of *Anaphothrips luteum*.  
 ——— add:

**Dichromothrips corbetti** (Priesner).

*Anaphothrips corbetti* Priesner, *Proc. Royal Ent. Soc. London* (B)5:209, 1936.

*Dichromothrips corbetti* (Priesner) Sakimura, *Proc. Hawaiian Ent. Soc.* 15(3): 592, figs. 3, 9, 15.

Kauai, Oahu, Hawaii.

Immigrant. Described from Kuala Lumpur, Malaya; Philippines. First found in Hawaii by Harold Lyon in 1950.

Hostplants: a pest of orchids, *Cattleya*, *Dendrobium*, *Miltonia*, *Renanthera storiei*, *Vanda*.

"DDT" has been used successfully in controlling this pest.

**Dichromothrips dendrobii** Sakimura.

*Dichromothrips dendrobii* Sakimura, *Proc. Hawaiian Ent. Soc.* 15(3):590, figs. 1, 4, 5, 10, 13, 14.

Oahu (type locality: Manoa).

Immigrant. Intercepted at Honolulu at various times on orchids coming from the Philippines, and found established in Honolulu by Sakimura in 1954.

Hostplants: *Dendrobium superbum*, *Phalaenopsis grandiflora*.

p. 405, add Lanai to localities of *Anaphothrips swezeyi*.

p. 406, add Lanai to localities of *Chirothrips mexicanus*.

——— add:

**Chirothrips patruelis** Hood.

*Chirothrips patruelis* Hood, *Revista de Entomologia* 11:550, 1940.

Hawaii.

Immigrant. Described from New York State. First recorded in the Territory by Bianchi (*Proc. Hawaiian Ent. Soc.* 1947:41), who had previously misidentified it as *Chirothrips mexicanus* (Bianchi, *Proc. Hawaiian Ent. Soc.* 1945:503).

Hostplants: swept from grasses.

p. 407, add Oahu to localities of *Aptinothrips rufa*.

p. 410, line 2, replace "three" with "several" and for a review of the genus, see Priesner, *Bull. Soc. Fouad I Ent.* 34:39–68, 1950.

——— add:

**Scolothrips pallidus** (Beach).

*Thrips pallida* Beach, *Proc. Iowa Acad. Sci.* 3:226, 1896.

*Scolothrips pallida* (Beach) Priesner, *Bull. Soc. Fouad I Ent.* 34:43, fig. 1, 1950.

*Scolothrips sexmaculatus*, as a misidentification, Zimmerman *Insects of Hawaii* 2:410, fig. 222a, 1948.

Oahu.

Immigrant. Described from America. Established in Hawaii for a number of years, but confused in local literature under *Scolothrips sexmaculatus*.

Hostplants: *Cajanus cajan* (pigeon pea), *Colocasia esculenta* (dryland taro), *Dianthus caryophyllus* (carnation).

See, also, the notes under the following species:

**Scolothrips priesneri** Sakimura.

*Scolothrips priesneri* Sakimura, *Proc. Hawaiian Ent. Soc.* 15(2):357, 1954.

*Scolothrips sexmaculatus*, as a misidentification in Hawaii.

Oahu (holotype locality: Manoa), Hawaii (allotype locality: Puuwaawaa).

Immigrant; source undetermined.

Hostplants: *Asystasia coromandeliana*, *Colocasia esculenta*, *Dodonaea viscosa*, *Erythrina monosperma*, *Eugenia uniflora*, *Ficus carica*, *Hibiscus rosa-sinensis*, *Ipomoea pentaphylla*, *Passiflora*, *Pluchea odorata*, *Sonchus oleraceus*, tomato, *Xanthium*.

Sakimura (*in litteris*) informs me that *sexmaculatus* has not been found in Hawaii and that the previous records of *sexmaculatus* in the islands are based upon misidentifications and include both *pallidus* and *priesneri*; but they refer mostly to *priesneri*. The material listed under *sexmaculatus* in *Fauna Hawaiiensis*, 1910, is *priesneri*. The two species may be separated as follows, according to Sakimura:

Proximal dark band on fore wing not reaching anterior wing margin, distal dark band broadly reaching anterior and posterior margins; Prothorax with prebasal setae well developed; body without any shading . . . . . **pallidus** (Beach).

Proximal and distal dark bands on fore wing both broadly reaching anterior and posterior wing margins; prothorax without prebasal setae; mesoscutellum deeply shaded . . . . . **priesneri** Sakimura.

p. 411, add Lanai and Johnston Island to localities and *Cattleya* and *Leucaena glauca* to hostplants of *Frankliniella sulphurea*.

——— add Maui to localities of *Organothrips bianchii*.

——— add:

**Frankliniella minuta** (Moulton).

*Euthrips minutus* Moulton, *U.S. Dept. Agr. Bur. Ent. (Tech. Ser.)* 12(3):56, pl. 4, figs. 32, 33.

Oahu, Lanai. Described from California. First found in the Territory by Sakimura at Maili, Waianae, Oahu, in October 1946, and first reported by him in *Proc. Hawaiian Ent. Soc.* 13(2):211, 1948.

Hostplant: *Verbesina encelioides*.

p. 413, add Maui to localities of *Docidothrips trespinus*.

p. 414, add Maui to localities of *Taeniothrips cyperaceae*.

p. 417, *Taeniothrips simplex* was reported established in England in 1950.

p. 419, add Hawaii to distribution of *Taeniothrips xanthius*.

——— add:

**Taeniothrips vitticornis** (Karny).

*Physothrips vitticornis* Karny, *Jour. Siam Soc.* 16(2):103, fig. 3, 1923.

Oahu.

Immigrant. Described from *Canavalia* in Siam. First found at Honolulu in 1952 by Davidson and Woolford.

Hostplant: either *Gardenia* or *Canavalia microcarpa* ("mauna loa").

p. 419, add Lanai and Hawaii to distribution of *Plesiothrips panicus*.

p. 425, add Lanai to distribution of *Thrips (Isoneurothrips) antennatus*.

p. 427, add *Myoporum sandwicense* as a host of *Thrips (Isoneurothrips) carteri*.

p. 428, add Hawaii to distribution of *Thrips (Isoneurothrips) fullawayi*.

p. 432, add:

**Liothrips urichi** Karny.

*Liothrips urichi* Karny, *Ann. Mag. Nat. Hist.* (IX)12:160, 1923.

The Clidemia thrips.

Oahu.

Described from Trinidad. Purposely introduced from Fiji in April, 1953, to aid in the control of its host, which is a pest plant. It was introduced from Trinidad to Fiji in 1930. See *Review of Applied Entomology* after 1930 for numerous references.

Hostplant: *Clidemia hirta*.

——— add:

**Parthenothrips dracaenae** (Heeger).

*Heliothrips dracaenae* Heeger, *Sitzungsb. Akad. Wiss. Wien* 14:365, 1852.

*Parthenothrips dracaenae* (Heeger) Uzel, *Monographie der Ordnung Thysanoptera*, 1895:171, pl. 2, figs. 13, 14; pl. 6, fig. 93.

Immigrant. Widespread in Europe and North America. Although first recorded in Hawaiian literature by Carter (*Proc. Hawaiian Ent. Soc.* 15(1):7) in 1953 from specimens collected in Honolulu in 1952, it was recorded earlier in the United States Department of Agriculture's *List of Intercepted Plant Pests*, 1951, and the latter report is based upon specimens intercepted on *Anthurium* being imported into Seattle, Washington, from Hawaii on August 8, 1950.

Hostplants: *Anthurium*, *Cordyline terminalis*.



p. 433, add to Phlaeothripidae:

**Pseudocryptothrips remotus** Bianchi.

*Pseudocryptothrips remotus* Bianchi, *Proc. Hawaiian Ent. Soc.* 1947:40, pl. 1, figs. C, E, F.

Maui (type locality: west rim of Haleakala Crater).

Immigrant?

Hostplant: *Dubautia*.

p. 438, delete references to figures after *Hoplothrips flavipes*.

——— add Molokai and Lanai to distribution of *Hoplothrips flavitibia*.

p. 441, *Karnyothrips flavipes* is *Cephalothrips errans* Moulton; add "(figures 216, b; 219)."

p. 442, add Maui to the localities of *Karnyothrips melaleuca*.

p. 444, add Maui to distribution of *Haplothrips fusca*.

——— add:

**Haplothrips (Haplothrips) fissus** Bianchi.

*Haplothrips (Haplothrips) fissus* Bianchi, *Proc. Hawaiian Ent. Soc.* 1947:37, figs. A, B, D.

Maui (type locality: Haleakala, near Puu Luau, 5,500 feet).

Endemic (?).

p. 445, add *Acacia koaia* to hostplants of *Haplothrips rosai*.

——— add:

**Haplothrips (Haplothrips) sesuvii** Priesner.

*Haplothrips sesuvii* Priesner, *Records Indian Mus.* 25:363, 1933.

Oahu, Maui.

Immigrant. Described from Java. First found in Hawaii by Bianchi at Barber's Point, Oahu, in 1949.

Hostplant: *Sesuvium portulacastrum*.

p. 453, add to bibliography: SAKIMURA, K. 1947. THRIPS IN RELATION TO GALL-FORMING AND PLANT DISEASE FORMATION: A REVIEW. *Proc. Hawaiian Ent. Soc.* 13(1):59-95. This is a detailed survey with an extensive bibliography.

## INDEX

p. 457, after "*Blatta punctata*," "*Blatta surinamensis*" and "Burrowing cockroach," change p. 93 to 94, and make the same change on p. 458 after "Cockroach, burrowing," and on p. 473 after "Surinam cockroach" and "*surinamensis*: *Blatta*; *Pycnoscelus*."

p. 471, add Sclerogibbidae, 195 to right-hand column of index.

## VOLUME III: HETEROPTERA

In 1951 (*Proc. Hawaiian Ent. Soc.* 14(2):333-336), I published a paper entitled "Notes on the Buchanan White Types of Hawaiian Heteroptera," and reference should be made to that paper for information on the various Hawaiian species described by Buchanan White. It is good to report that the Buchanan White collection has now been transferred to the British Museum (Natural History).

p. 4, reverse the alphabetical position of *Nysius fullawayi infuscatus* and *fullawayi flavus*.

- p. 9, for "Halticarini," read "Halticini."  
 p. 19, paragraph 4, line 10, for "first three" read "third (second visible), fourth and fifth."  
 p. 24, last line of dichotomy 20(19) read "with trichobothria" instead of "without."

## PENTATOMIDAE

- p. 27, add *Acacia confusa* and *Acacia koaia* to hostplants of *Coleotichus blackburniae*.  
 p. 30, add broccoli, Brussels sprouts, kale and mustard greens to hostplants of *Murgantia histrionica*, and add *Trissoclus murgantiae* Ashmead (Hymenoptera: Scelionidae) as a parasite.  
 p. 40, add larvae of *Anacamptodes fragilaria* (Grossbeck) and *Mapsidius chenopodii* Swezey as hosts of *Oechalia pacifica*, and add Hawaii to localities.

## COREIDAE

- p. 46, Ithamar is a biblical character (see Leviticus, for example).

## LYGAEIDAE

- p. 51, add *Ipomoea pes-caprae* to *Graphostethus manillensis* hostplants.  
 p. 58, in line 2 of dichotomy 1, after "hairs;" add "examine in side view as well as dorsally, hairs may be obscured in dirty or greasy examples."  
 p. 59, in line 2 of dichotomy 9(4), after "reaching," add "to about."  
 p. 60, bottom line, add "pale or" before "clear."  
 p. 61, remove descriptive notes on pronotum in each part of dichotomy 22, and after "ferrugineous" in the *parvulus* section of the dichotomy, add ", at most with a black spot in the brown callosity."  
 p. 62, in line 2, dichotomy 2(1), after "extending," add "about," and in line 2, dichotomy 10(8) after "reaching," add "to or about to."  
 p. 63, line 1 of dichotomy 1 under Section E, after "conspicuous" add "in clean examples."  
 p. 64, after *Oceanides arboricola*, change "figure 23" to "figure 24;" in synonymy put "Not" in front of "*Oceanides arboricola* (White) Usinger," and for "pls. 2, 6" in that line, read "pl. 2, C"; add to synonymy: *Oceanides parvulus* Usinger, 1942:30, pl. 3, C. Synonymy by Zimmerman, *Proc. Hawaiian Ent. Soc.*, 1951: 333.  
 p. 65, line 1 of figure legend, for "*O. arboricola* (White)," read "*O. usingeri* Zimmerman."  
 p. 67, line 4 of figure legend, for "*O. parvulus* Usinger," read "*O. arboricola* (White)."  
 p. 69, delete *Oceanides parvulus* and transfer the data to p. 64 under *Oceanides arboricola*.  
 p. 71, after the *Oceanides sinuatus* section insert:  
***Oceanides usingeri* Zimmerman.**  
*Oceanides usingeri* Zimmerman, *Proc. Hawaiian Ent. Soc.* 1951:333.  
*Oceanides arboricola* of Usinger, 1942: 41, pl. 2, c, not *arboricola* White, 1878:368.  
 p. 101, *Nysius fullawayi infuscatus* is out of alphabetical order and should follow *fullawayi flavus*.

- add Niihau to distribution of *Nysius fucatus*.
- p. 104, add *Acacia koaia* to hostplants of *Nysius nigriscutellatus*.
- p. 105, add Johnston Island to distribution of *Nysius terrestris*.
- p. 108, I have examined the holotype of *Metrarga nuda nuda*, and it is labeled "Honolulu."
- p. 110, the figure labeled *Nesocryptias villosa* is not *villosa*, but it represents a new species.
- p. 111, for line 4, read "New species have been seen from Kauai, Oahu and Hawaii." Under *Nesocryptias villosa*, remove "Kauai." I have examined the two males in White's type series and find them to be quite distinct from my figure. The pronotum is differently shaped: the anterior part of the side margin is broadly arcuate and not strongly protuberant as in my figure. With an eye-piece micrometer reading 20 units to 1 mm., some measurements on the holotype are as follows: pronotum 18 long, breadth between hind angles 31, narrowest part across dorsum between lateral constrictions 28, breadth at about apical third 30; breadth across eyes 23.5; hemelytra from base of pronotum to apex 61, extreme breadth of hemelytra 47, length of membrane 27; antennal segments 1-11, 2-15, 3-17, 4-15. The ocelli are well developed, well elevated, red or pink. The rostrum (in the male) extends to a line just behind the trichobothria on the second abdominal segment.

## TINGIDAE

- p. 121, add Tribe Tingini and add:

**Corythucha morrilli** Osborn and Drake.

*Corythucha morrilli* Osborn and Drake, *Ohio Jour. Sci.* 17:298, 1917.

Oahu.

Immigrant. Widespread in North America, Mexico and West Indies. First found at Lualualei, Oahu, in July, 1953, by Hardy and others (*Proc. Hawaiian Ent. Soc.* 15(2):282, 1954).

Hostplants: *Ambrosia artemisiaefolia*, *Pluchea indica*, *Verbesina encelioides*, *Xanthium* (cocklebur).

- p. 122, add *Myoporum sandwicense* to host list of *Teleonemia scrupulosa*, the first record of this species attacking a host other than *Lantana*. However, it should be noted that introductions of what have been called "strains" of the *Teleonemia* have recently been made, and this problem requires investigation. Do all of the new introductions represent populations which are entirely identical with the original stock which has for so long confined its attention to *Lantana*?

## REDUVIIDAE

- p. 125, add:

**Emesopsis nubilis** Uhler.

*Emesopsis nubilis* Uhler, *Proc. Zool. Soc. London*, p. 718, 1893.

*Emesopsis pilosus* Usinger, *Bishop Mus. Bull.* 189:42, fig. 7, 1946. Synonymy according to Wygodzinsky, *in litteris*.

Oahu.

Immigrant. First taken in December, 1954, in a light trap at Ewa. Described from the West Indies and recorded (as *pilosus*) by Usinger from Guam.

- p. 126, the type of *Luteva insolidia* came from Oahu. Further study of all available specimens should be made; there is more than one species involved.

p. 128, I have seen *Empicoris rubromaculatus* feeding on psocids.

p. 131, for additional notes on *Triatoma rubrofasciata*, see Bonnet, *Proc. Hawaiian Ent. Soc.* 13(1):15, 1947.

p. 137, add Niihau to the distribution of *Zelus renardii*.

p. 138, at end of page, add:

***Polididus armatissimus* Stål.**

*Polididus armatissimus* Stål, *Öefv. Vet. Ak. Forh.*, p. 376, 1859.

Hawaii.

Immigrant. Widespread in southeast Asia, Philippines, etc. First collected in the Territory by R. Sato at Pahoehoe, Hawaii, in August, 1953, and recorded by Chilson in 1954 (*Proc. Hawaiian Ent. Soc.* 15(2):289).

***Melanolestes picipes abdominalis* (Herrick-Schaeffer).**

*Pirates abdominalis* Herrick-Schaeffer, *Die Wanzenartigen Insecten* 8:63, pl. 269, fig. 832, 1846.

*Melanolestes picipes* variety *abdominalis* (Herrick-Schaeffer) Stål, *Köngl. svenska Vetenskaps-Akademiens Handlingar* 10(4):107, 1872.

Oahu.

Immigrant. Widespread in North America. First reported by me in 1948 (*Proc. Hawaiian Ent. Soc.* 13(2):218) from a specimen found in a light-trap catch by Rosa at Iroquois Point, Pearl Harbor, October, 1947.

Bugs of this genus have been reported to prey upon the larvae of Scarabaeidae.

p. 138, bottom, add the subfamily Acanthaspinae to include the following species:

***Peregrinator biannulipes* (Montrouzier and Signoret).**

*Opiscoetus biannulipes* Montrouzier and Signoret, *Ann. Soc. Ent. France* (4)1:69, 1861.

*Alloeocranum biannulipes* (Montrouzier and Signoret), Kirkaldy, *Fauna Hawaiiensis* 3(2):150, pl. 4, fig. 17.

*Peregrinator biannulipes* (Montrouzier and Signoret) China, *Ann. Mag. Nat. Hist.* (9)15:164, 1925.

For synonymy and notes, see China, *Insects of Samoa* 2(3):155, 1930. For additional illustrations, see Villiers, *Fauna de l'Empire Francaise* 9:283, 1948.

Oahu.

Immigrant. Widespread in Central and South America, West Indies, Africa, Madagascar, islands of the Indian Ocean, Indochina, Malaysia, Philippines, Guam, New Caledonia, Fiji, Samoa, Tahiti, Marquesas and other islands; carried far and wide by commerce.

A single specimen of this species was collected on Oahu by Dr. Perkins before the turn of the century. I did not record the species in my third volume of *Insects of Hawaii*, because no other example had been found in Hawaii and I did not consider that the species was established. I should, however, have mentioned the record in *Fauna Hawaiiensis*, but although I had notes on the species in my original manuscript, reference to it did not get into my printed volume. It is now included because E. Sawa collected two examples in the Barber's Point area in December, 1953 (*Proc. Hawaiian Ent. Soc.* 15(3):376, 1955). We cannot tell whether the species has been introduced and established on more than one occasion or not, but I consider that it is more likely that the new discovery does rep-

resent a new introduction. A conspicuous insect such as this is not apt to be overlooked by collectors for so many years. I cannot agree that this widespread insect is a "native of the Waianae section" as suggested in the foregoing reference.

p. 145, in first line of second paragraph of dichotomy "11(7)" add "strongly" after "not."

p. 148, line 1, the holotype of *Nabis blackburni* is now in the British Museum.

#### ANTHOCORIDAE

p. 177, last line of key, read "second antennal segment" for "first antennal segment."

p. 178, add *Amphiareus* Distant, 1904, and *Lippomanus* Distant, 1904, to synonymy of *Cardiastethus*. Remove *Xylocoris fumipennis* Walker from synonymy; Distant was in error in creating the synonymy, because *fumipennis* does not belong to the genus. (These details given me in 1949 by W. E. China.)

p. 179. *Buchaniella* should be used instead of *Poronotellus*. In 1949, Dr. China kindly gave me the following information: Reuter, in 1871, (*Öfv. Vet.-Ak. Förh.* 28:561) erected *Poronotus* for *Xylocoris discifer* Stål and *Xylocoris constrictus* Stål, both from Brazil. In 1885, Reuter (*Act. Soc. Sci. Fennicae* 14:557-758) dropped his genus *Poronotus* (possibly because *Poronotus* was preoccupied by *Poronotus* Gill, 1861, Pisces) and transferred *Poronotus discifer* Stål to *Cardiastethus* Fieber, 1860 (type *C. luridellus* Fieber) and *Poronotus constrictus* to *Asthenidea* Reuter, 1885 (type *A. temnostethoides* Reuter). In 1900, Champion (*Biologia Centrali Americana*, Insects, Rhynchota, Heteroptera 2:333) pointed out the existing anomaly and virtually fixed *P. constrictus* Stål as the type of *Poronotus* Reuter. In 1904, Kirkaldy (*The Entomologist* 37:280) renamed *Poronotus* Reuter, 1871 (not Gill, 1861) *Porontellus*, which thus has *constrictus* Stål as its type. In 1909, Poppius (*Act. Soc. Sci. Fennicae* 37(9):15) drew attention to Champion's statement and pointed out that *Poronotus* as fixed by Champion is identical with *Buchaniella* Reuter, 1885 (*Act. Soc. Sci. Fennicae* 14:680) whose type is *Cardiastethus continuus* B. White. He, therefore, said that *Buchaniella* Reuter, 1885, should become a synonym of *Poronotus* Reuter, 1871, but he overlooked the fact that Reuter's *Poronotus* is preoccupied by the *Poronotus* of Gill. Thus, Kirkaldy's *Porontellus* is not needed and must fall as a synonymy of *Buchaniella*, which is the genus we should now use. The type of *sodalis* came from Oahu.

#### CRYPTOSTEMMATIDAE

p. 179, in the bottom line read "*coleoptrata*" for "*cleopatrata*."

p. 180, *Ceratocombus hawaiiensis* Usinger has been found in rotting *Pandanus* fruit on Arno Atoll, Marshall Islands, by Usinger (*Proc. Hawaiian Ent. Soc.* 1951:319).

#### MIRIDAE

p. 185. I collected *Campylomma hawaiiensis* on *Sida* on the Waianae coast of Oahu in 1952. It is green in life, whereas old specimens previously seen were faded to pale yellowish.

pp. 188-189. Drs. W. E. China and J. C. M. Carvalho have published a revision of the *Cyrtopeltis-Engytatus* group, and the names in use in Hawaii should be altered to conform to the new opinions rendered. The revision is: The "*Cyrtopeltis-Engytatus*" Complex, *Ann. Mag. Nat. Hist.* (xii)5(50):158-166, figs. 1-3, 1952. In this paper *Engytatus* is reduced to a subgenus of *Cyrtopeltis*. The described Hawaiian forms may now be known as follows:

**Cyrtopeltis (Engytatus) confusa** (Perkins).*Cyrtopeltis confusa* Perkins, 1912:729.*Engytatus confusus* (Perkins) Usinger, 1946:75.*Cyrtopeltis (Engytatus) confusa* (Perkins) China and Carvalho, 1952:160.**Cyrtopeltis (Engytatus) modesta** (Distant).*Engytatus geniculatus* Reuter, 1876:83.*Cyrtopeltis geniculatus* (Reuter), of authors, not Fieber.*Cyrtopeltis varians*, as a misidentification in Hawaii, not of Distant.*Neosilia modesta* Distant, 1893:447.*Dicyphus luridus* Gibson, 1917:218.*Cyrtopeltis (Engytatus) luridus* (Gibson) China and Carvalho, 1952:190, figs.

China and Carvalho have used the masculine form of the noun, but *Cyrtopeltis* is feminine, and the trivial name should agree in gender with the generic name. Hence the specific name should be *lurida*. Through a *lapsus*, they used Gibson's 1917 name, whereas we should use the earlier Distant name.

Sailer, quoted by Chilson in *Proc. Hawaiian Ent. Soc.* 1954:275, identified specimens of this species as *Cyrtopeltis varians* (Distant) and said

... this is the same species as that treated by Zimmerman "Insects of Hawaii," 3:190, 1948 under the name *Engytatus geniculatus* Reuter, and the use of *C. varians* is not a misidentification as shown by Zimmerman. Zimmerman's usage is based on Usinger's treatment of the species in his paper on the Guam Heteroptera. His conclusions were based on a study of three species and I question the advisability of accepting this change until it is shown that the remaining species can be placed in one or another of the genera as he accepts them. Furthermore, *geniculatus* is a secondary homonym, and, depending upon action of the International Commission of Zoological Nomenclature, might have to be replaced by *variens*.

Evidently Sailer had overlooked the detailed China and Carvalho revision of 1952, and he is in error in stating that I am wrong in saying that the use of the name *Cyrtopeltis varians* for this species is based upon a misidentification in Hawaii. It is not the *Cyrtopeltis varians* of Distant; I have seen the type of *variens*. Several years ago I compared Californian and Hawaiian examples with *Engytatus geniculatus* Reuter in the British Museum and found them to agree perfectly, including the male genitalia. They also resemble, superficially, Distant's *variens*, but the male genitalia are obviously quite different. The question of the homonym (*Cyrtopeltis geniculata* Fieber, 1860; *Engytatus geniculatus* Reuter, 1876) need not confuse us further, because Distant's *modesta* is available.

**Cyrtopeltis (Engytatus) hawaiiensis** (Kirkaldy).*Cyrtopeltis hawaiiensis* Kirkaldy, 1902:138.*Engytatus hawaiiensis* (Kirkaldy) Usinger, 1946:75.*Cyrtopeltis (Engytatus) hawaiiensis* (Kirkaldy) China and Carvalho, 1952:190.

p. 197, add:

**Fulvius brevicornis** Reuter.*Fulvius brevicornis* Reuter, *Entomologisk Tidskrift* 16:138, 1895.

Oahu.

Immigrant. Described from Rouen, France, but probably introduced from Senegal; now known to be widespread by commerce.

This species was first recorded by name by me in 1949 (*Proc. Hawaiian Ent. Soc.* 13(3):341) from specimens taken at a light trap at Iroquois Point, Pearl Harbor, in 1947. It is possibly a recovery of the species purposely introduced by

the Hawaiian Sugar Planters' Experiment Station from the Philippines many years ago as a possible predator on the weevil *Rhabdoscelus obscurus* (Boisduval).  
 p. 198. For "Halticini" in the key and the heading below, read "Halticini."  
 p. 206, add Maui to the distribution of *Cyrtorhinus fulvus*.

— add:

***Cyrtorhinus lividipennis* Reuter.**

*Cyrtorhinus lividipennis* Reuter, *Entomologisk Tidskrift* 5:199, 1884.

The corn leafhopper egg-sucking bug.

Oahu.

Purposely introduced from Guam in 1952 and recorded established in 1953 at Kaneohe. It was introduced in 1939, but it failed to become established at that time. It was originally described from Nicobar.

Host: it feeds upon the eggs of the corn leafhopper, *Peregrinus maidis* (Ashmead).

p. 207, *Cyrtorhinus mundulus* has been successfully raised on the eggs of *Draeculacephala* in the laboratory (see *Proc. Hawaiian Ent. Soc.* 14(2):218, 1951). J. S. Verma (*Proc. Hawaiian Ent. Soc.* 15(3):623-634, fig. 1, 1955) has published a paper titled "Biological Studies to Explain the Failure of *Cyrtorhinus mundulus* (Breddin) as an Egg-predator of *Peregrinus maidis* (Ashmead) in Hawaii."

p. 208. T. R. E. Southwood has published a useful study entitled "The Morphology and Taxonomy of the Genus *Orthotylus* Fieber, with Special Reference to the British Species" (*Trans. Royal Ent. Soc. London* 104(11):415-449, 152 fig., 1953) which can be used as an excellent guide to future investigations of Hawaiian *Orthotylus*. Following Southwood's classification, the Hawaiian *Orthotylus* may be placed in the subgenus *Melanotrichus* Reuter, 1875.

p. 209. I have had an opportunity to study the types of Hawaiian *Orthotylus* in the British Museum, and I have revised the key to the species. This key is based on color, and it is only provisional. When the Hawaiian complex is studied in proper detail, a new key, based primarily on structure, will have to be made. In the meanwhile, however, the following key may be substituted for the one I published in Volume 3:

KEY TO THE HAWAIIAN ORTHOTYLUS

1. Color mostly reddish, veins of membrane red . . . . . 2  
 Color mostly green, greenish, yellowish, testaceous or fuscous (sometimes with a slight reddish tinge, but never distinctly red, although the veins of membrane may be red) . . . . . 3
- 2(1). Cuneus entirely red, pale only along fracture; almost uniformly red species, not conspicuously maculate . . . . . type of **kekele** Kirkaldy.  
 Cuneus not entirely red, but interrupted by a broad, irregular, median, transverse white band and tip white; crown of head white with a red V in type; strongly maculate species . . . . type of **daphne** Kirkaldy.
- 3(1). Uniformly green, greenish or testaceous, immaculate . . . . 4  
 Always more or less infuscated . . . . . 5

- 4(3). Pale green (fading to pale yellow); pubescence entirely pale.....type of **iolani** Kirkaldy.  
 Dark green or bluish green; pubescence brownish.....  
 .....type of **perkinsi** Kirkaldy.
- 5(3). Pronotum pale testaceous (sometimes speckled with red anteriorly), with a distinct, dark brown, subtriangular mark in middle, its base along posterior margin and its apex extends along median line and just reaches onto base of crown of head..female type of **azalais** Kirkaldy.  
 Pronotum without such a color pattern.....6
- 6(5). Head, pronotum and inner apices of coria immaculate..  
 .....type of **tantali** (Perkins).  
 Head, pronotum and inner apices of coria with fuscous markings.....7
- 7(6). Cuneus with a dark red band across apical half leaving extreme apex and basal half yellowish (sometimes pinkish?); apical margin of corium surrounding cuneus pale pink; veins of membrane red; pronotum of female largely blackish (type of *daphne kassandra* Kirkaldy)  
 .....some **daphne** Kirkaldy.  
 Cuneus uniformly pale (female allotype) or with marginal infuscation (male holotype) which is sometimes reddish; veins of membrane brown; pronotum of female allotype with a large pallid, median, anterior area, this pallid area small on male holotype.....  
 .....holotype and allotype of **kanakanus** Kirkaldy.

The sexes of the British Museum types illustrated on pages 210 and 211 of Volume 3 were not indicated in the text. I have examined them and the sexes are as follows: *azalais*, *daphne*, *iolani*, *kassandra* and *kekele* are females; *kanakanus* and *perkinsi* are males.

p. 210. The figure of the type of *azalais* is somewhat misleading, because the hind femora are yellowish, but they are fuscous on a paratype. The following color notes may be marked on my figure: basal segment of antenna fuscous; spots on head and fore part of pronotum reddish; on remainder of pronotum and hemelytra the dark color is dark fuscous and the pale color is yellow.

The following color notes may be added to the figure of *daphne*: head white, the A-shaped mark red; pronotum largely brownish-yellowish, hemelytra mostly red, with the pale areas on cuneus white; hind femora red, hind tibiae yellow.

p. 211. On figure **a** of *kanakanus*, the dark color is mostly brownish fuscous; the cuneus is margined with fuscous.

On figure **b** of *kassandra*, the A-shaped area on crown of head is fuscous tinged with red; the pronotum is blackish; the pale areas on the scutellum and hemelytra are yellow, the dark areas red with the sides of the corium and the dark area in the cuneus pink.

On figure **c** of *kekele*, the first antennal segment is red; the anterior legs are yellow, the posterior femora red and the posterior tibiae yellow; the specimen is dorsally red overall; the veins of the membrane are red.



- p. 212. Under *kanakanus* it is stated that the type is a teneral example, but I have now examined the type and I consider that it is not a teneral specimen.

After study of the type, I now consider that *Orthotylus kassandra* is not a distinct species. The name has been applied to a dark specimen of *daphne* and therefore *kassandra* should become a **new synonym** of *daphne*.

Under *Orthotylus kekele* read "*Tichorhinus kekele*" for "*Tichorhinus kassandra*."

- p. 215, bottom line, read "right" for "left."

- p. 216. *Oronomiris* Kirkaldy is a synonym of *Trigonotylus* Fieber, and the latter name is to be used for our species, and add:

***Trigonotylus usingeri* Carvalho.**

*Trigonotylus usingeri* Carvalho, *Boletim do Museu Nacional, Rio de Janeiro, Brazil* (new series, *Zoologia*) 111:1-3, fig. 1, 1952.

Endemic. Hawaii (type locality: one mile north of Humuula).

Hostplant: native grass.

This is one of our brachypterous species, several more of which are in collections in addition to a large number of new macropterous species.

**SALDIDAE**

- pp. 221-224. My key to the Hawaiian *Saldula* is worthless because the material I had to work with in Honolulu was partly misidentified, as was part of the material used for the illustrations. *Saldula humifera* is not a synonym of *oahuensis*. The figure labeled *oahuensis* is *humifera*, and the figure labeled *procellaris* is *oahuensis*. The following key may be substituted for the one in the text:

**KEY TO THE HAWAIIAN SALDULA**

1. Second and fourth antennal segments subequal in length (2, 17; 4, 16 on type); hemelytra very narrowly overlapping and apices conspicuously divergent to form a conjoint emargination from two-thirds the distance from end of clavi to apex (on type), as in my figure 100 ..... **nubigena** (Kirkaldy).  
 Second antennal segment distinctly longer than fourth; hemelytra more strongly overlapping and at most only slightly conjointly emarginate at apex.....2
- 2(1). A line drawn through middles of ocelli passes through middle of posterior pale frontal spots; lateral carinate edges of pronotum usually pale as seen from above, but frequently the pale color is obscure from above but is distinct on sides beneath the edge, or at least at posterior part of edge..... **exulans** (White).  
 A line drawn through middles of ocelli passes along anterior margins of posterior pale frontal spots, or in front of the spots.....3
- 3(2). Femora each with a wide, dark, median band.....  
 ..... **humifera** (Kirkaldy).  
 Femora without such a dark band.....4

- 4(3). Corium with a dark band along clavus from humerus to apex of clavus where it gives way to a pale spot on inner (sutural) margin of corium. .**procellaris** (Kirkaldy).

Corium broadly pale along clavus from humerus to inner (sutural) margin of corium, without any dark mark reaching clavus from corium except at extreme base, although the black of clavus may extend narrowly across claval suture onto corium. .**oahuensis** (Blackburn).

#### VELIIDAE

- p. 228, add *Enallagma civile* (Hagen) (Odonata) as a predator of *Microvelia vagans*.

#### ADDENDUM

- p. 237. The combination *Coriscus pilosulus* is incorrect, and we should return to *Alydus pilosulus* Herrick-Schaeffer. I have now seen the original reference. It should read *Die Wanzenartigen Insecten* 8:101, pl. 173, fig. 870, 1846. The actual date of issue of this part of Herrick-Schaeffer's work was 1846, not 1848 as printed on part of the work and the date usually quoted. The species was described from North America.
- p. 238, add *Cassia leschenaultiana* (partridge pea, Japanese tea) and indigo to hostplants of *Alydus pilosulus*.

#### LITERATURE

- p. 239. After the Blatchley reference, insert BREDDIN, G. 1896. JAVANISCHE ZUCKERROHRSCILDINGE AUS DER FAMILIE RHYNCHOTEN. Deut. Ent. Zeit. 105-110.
- p. 240. After Frost and Haber, add GERMAR, E. F. 1837 [1838]. HEMIPTERA HETEROPTERA PROMONTORII BONAE SPEI, NUDUM DESCRIPTA, QUAE COLLEGIT C. F. DREGE. In: Silbermann's Revue Entomologique 5:121-192.

### VOLUME IV. HOMOPTERA: AUCHENORHYNCHA

#### CERCOPIDAE

- p. 19, add the following to the list of hostplants of *Philaenus spumarius*, and add C. J. Davis, *Proc. Hawaiian Ent. Soc.* 13(1):30-31, 1947 to references. *Acanthospermum australe*, *Alyxia olivaeformis*, *Beta* (Swiss chard), *Brassica oleraceae gemmifera*, *Chenopodium oahuensis*, *Chrysanthemum*, *Eupatorium reparium*, *Fragaria chiloensis*, *Fuchsia arborescens*, *Hedychium coronarium*, *Ipomoea congesta*, *Kokia rockii*, *Lonicera japonica*, *Lycopersicon esculentum*, *Oxalis corniculata*, *Pelargonium graveolens*, *Pipturus*, *Rosa*, *Sambucus*, *Sesuvium portulacastrum*, *Sideroxylon*, *Styphelia*, *Tropaeolum*, *Vaccinium reticulatum*.

#### CICADELLIDAE

It would have improved my report on the Cicadellidae considerably if I had had available Oman, "The Nearctic Leafhoppers (Homoptera: Cicadellidae). A Generic Classification and Check List." *Mem. Ent. Soc. Washington* 3:1-253, pls. 1-44, 1949. That monograph is a most useful contribution.

- pp. 22-24. The use of *Acopsis* is in error. *Draeculacephala* is a distinct genus and should be returned to use. A helpful paper on the genus is: E. D. Ball and W.

E. China, "Notes on Walker's Types of North American Leafhoppers of the Genus *Draeculacephala* together with new species." *Jour. Kansas Ent. Soc.* 6(1):1-4, figs. 1933. Add *Eleusine* and Job's tears to hostplants of *Draeculacephala mollipes*.

p. 27, add orchids to hostplants of *Empoasca solana*.

—— before *Jassinae*, add:

**Kunzeana kunzei** (Gillette).

*Dicraneura kunzei* Gillette, *Proc. U.S. National Mus.* 20(1138):721, 1898.

*Kunzeana kunzei* (Gillette) Oman, *Mem. Ent. Soc. Washington* 3:83, pl. 34, fig. 6, 1949. Type of *Kunzeana*.

Oahu.

Immigrant. Described from Arizona. First found in Hawaii at a light trap at Ewa, Oahu, in December, 1954, and since taken there and at nearby Waipio, Oahu.

Hostplant: *Acacia farnesiana*; the members of the genus feed on legumes.

pp. 34-35. R. Namba has written "The Genus *Nesophryne* Kirkaldy, with Description of a New Species" (*Proc. Hawaiian Ent. Soc.* 15(3):571-574, figs. 1-3, 1955) in which he figures the genitalia of the species, gives a new key and describes the following new species:

**Nesophryne alticola** Namba.

*Nesophryne alticola* Namba, *Proc. Hawaiian Ent. Soc.* 15(3):572 fig. 1, 1955.

Oahu (type locality: Malamalama), Lanai.

This is one of the new species I referred to on page 32 of my fourth volume. There are more new species to be described.

p. 47, in third and fourth lines under "3," for "striped longitudinally with black" read "blackish on edges at insertions of spines."

p. 50. The type of *Nesophrosyne opalescens* (which I could not place in the key because I did not know it) runs to dichotomy 18(15).

p. 66. The following color notes on the types may be added; on *nubigena* the tegmina are pale yellowish-hyaline with narrow brown stripes along veins; the head and prothorax were missing from the type (a female) when I examined it at the British Museum in June, 1951. The pale head, pronotum and scutellum of the *opalescens* type are yellow; in dorsal view, the head measurements are: extreme length to hind edge of eye 16 units, breadth 43. The same measurements of the type of *paludicola* are 17 long and 46 wide.

p. 75. It would be worth while to have *Nesophrosyne sinuata* Osborn compared with the type of *umbrigena* Kirkaldy.

p. 76. The head measurements on the type of *silvigena* are 15 long and 52 wide. The female type of *umbricola* may be teneral; the head measurements are 19 long and 55 wide; the tegmina are yellow-hyaline, slightly dusky basad and dark only as noted in my figure b, and the veins are not dark. The male type of *umbrigena* has the pronotum shiny black and the head measurements are 18 long and 51 wide.

pp. 79-80. Representatives of what is called *Nesorestias insularis* and figured by me should be sent to the British Museum for comparison with the holotype. I have seen the holotype in London.

p. 82, add:

**Scaphytopius (Convelinus) loricatus** (Van Duzee).

*Platymetopius loricatus* Van Duzee, *Bull. Buffalo Soc. Nat. Hist.* 5:205, 1894.

*Scaphytopius (Convelinus) loricatus* (Van Duzee) Oman, *Mem. Ent. Soc. America* 3:102, 1949.

Oahu.

Immigrant. Known from Texas to California. First taken in Hawaii by Joyce in a light trap in Honolulu in August, 1953 (*Proc. Hawaiian Ent. Soc.* 15(2):287, 1954).

——— add:

**Deltocephalus sonorus** Ball.

*Deltocephalus sonorus* Ball, *Canadian Entomologist* 32:344, 1900.

Oahu.

Immigrant. Described from Arizona and distributed across the southern United States from Florida to California. First found in Hawaii by Pemberton in a light trap at Ewa, Oahu, in July, 1952 (*Proc. Hawaiian Ent. Soc.* 15(2):279, 1954).

Hostplant: *Cynodon dactylon*.

p. 83, line 4 from bottom, *Polynema saga* is now known as *Barypolynema saga*.

——— add Maui to localities of *Opsius stactogalus* and *Stragania robusta*.

——— add:

**Exitianus exitiosus** (Uhler).

*Cicadula exitiosa* Uhler, *American Entomologist* 3:72, 1880.

*Exitianus exitiosus* (Uhler) Ball, *Trans. American Ent. Soc.* 55(1):5, 1929. For synonymy, see Van Duzee, "Catalogue of the Hemiptera of America North of Mexico." *Univ. California Pubs. in Ent.* 2:1-902, 1917.

Kauai, Oahu.

Immigrant. Widespread in North America and the West Indies. First found at a light trap at Iroquois Point, Pearl Harbor, Oahu, in October, 1947 (*Proc. Hawaiian Ent. Soc.* 13(3):323, 1949). I found it on Kauai in July, 1952.

This is the type of *Exitianus*. Essig, in *Insects of Western North America*, calls it "the destructive leafhopper" and notes that "It may often be present in swarms and is destructive to grasses and grains." DeLong and Hershberger have revised the genus and have given a key and illustrations to the species (*Ohio Jour. Sci.* 47(3):107-116, pls. 1, 2, 1947).

#### MEMBRACIDAE

p. 89, bottom, add: Tribe Polyglyptini Goding, to include:

**Vanduzee segmentata** (Fowler).

*Hypamastris segmentata* Fowler, *Biologia Centrali-Americana*, Insecta, Rhynchota, Hemiptera-Homoptera. 2(1):93, pl. 6, figs. 23, 23a-b, 1894.

Oahu, Molokai, Maui, Hawaii.

Immigrant. Widespread from Central America to southern United States. First recorded in Hawaii by Inada in 1949 (*Proc. Hawaiian Ent. Soc.* 13(3):337) from specimens found in Honolulu in April and August, 1948.

Hostplants: *Bidens pilosa*, *Cajanus indicus* (pigeon pea), *Cassia bicapularis*, *Cassia* sp., *Casuarina*, eggplant, *Emelia sonchifolia*, *Erigeron*, gorse (feeding on?), *Macadamia ternifolia*, *Medicago sativa* (alfalfa), *Pluchea indica*, *Prosopis*, *Solandra guttata* (cup-of-gold), *Trifolium subterraneum* (subterranean clover), *Verbesina encelioides*.

## DELPHACIDAE

- p. 142. Revise the key as follows: line 1, read "2(1)" for "1" and "3" for "2"; line 3, read "1" for "2(1)"; line 6, after "space" insert "which is hyaline and forms a pale basal band across tegmina"; at end of line 13, change "3" to "2."
- p. 145. I have examined the female type of *Leialoha pacifica* in the British Museum. It is a distinctive species which should be easily recognized when seen. The type locality label is confused as noted in my text.
- p. 151. The type of *Nesothoë laka* runs to *terryi* in my key. The tegminal veins are conspicuously dotted with small but outstanding brown dots at the bases of the setae.
- p. 203, add:

**Nesosydne chenopodii** Zimmerman.

*Nesosydne chenopodii* Zimmerman, *Proc. Hawaiian Ent. Soc.* 14(3):433, figs. A-D, 1952.

Endemic. Hawaii (type locality: Pohakuloa, above 6,500 feet).

Hostplant: *Chenopodium oahuense*.

In my general key to the species of *Nesosydne*, *chenopodii* runs to "9(8)" on p. 177, and in my key to the *Nesosydne* of the island of Hawaii, it runs to "6(5)," but it will not fit any of the alternates.

- p. 208, line 3 under *Nesosydne halia*, add "1926:378, figures 11, 12" to references.
- p. 222, add *Acacia koaia* to hostplants of *Nesosydne rubescens*.
- p. 224, line 6 from bottom between "b." and "New" add "1926:378, figs. 9, 10" (the original material on which this last reference was based should be checked, because the determination may be incorrect).
- p. 230. Pemberton has published an account of the life history of *Perkinsiella saccharicida* in *The Hawaiian Planters' Record* 53(4):205-210, 1950. Add corn to the list of occasional hostplants.
- p. 238. For notes on *Peregrinus maidis* ovipositing in the roots and underground parts of the stems of corn plants, and in *Cyperus rotundus* growing in the vicinity of corn plants, and the interrelations of the leafhoppers and ants, see Verma, *Proc. Hawaiian Ent. Soc.* 15(2):276-277, 1954. Add *Cyrtorhinus lividipennis* Reuter (Hemiptera: Miridae) as a predator.

- pp. 241, 242. Use *Sogata* in place of *Liburnia*, which is said by Fennah to be a synonym of *Embolophora* Stål.
- p. 246, line 4 of figure legend, insert "f, genital styles" before "g."

## FLATIDAE

- p. 249, add *Acacia koaia* to hostplants of *Siphanta acuta*.

## VOLUME V. HOMOPTERA: STERNORHYNCHA

## PSYLLIDAE

- p. 14, line 3, delete "Leviinae."

——— insert Subfamily **LEVIINAE**, Tribe Aphalarini, and add:

**Aphalara rumicis** (Mally).

*Aphalara exilis* variety *rumicis* Mally, *Proc. Iowa Acad. Sci.* 2:166, 1895.

*Aphalara rumicis* (Mally) Crawford, *U.S. Nat. Mus. Bull.* 85:29, figs. 164, 384, 501, 1914.

Oahu.

Immigrant. Described from Iowa; widespread in western United States. First found in Hawaii by Tuthill, who collected it "on a ridge overlooking Nuuanu Valley" in March, 1947 (*Proc. Hawaiian Ent. Soc.* 13(2):204, 1948).

It may be expected to attack *Rumex*.

#### APHIDIDAE

p. 64, in synonymy of *Tuberolachnus salignus*, add the combination *Pterochlorus saligna* (Gmelin).

p. 76. Replace "*Aphis ferruginea-striata*" with "*Sappaphis foeniculus* (Theobald)." See *Journ. Econ. Ent.* 45:752, 1952.

p. 81, to the list of hostplants of *Aphis medicaginis*, add *Cacara erosa* (yam bean) and *Mimosa pudica*.

p. 85, add *Amaranthus gracilis* to the hostplants of *Aphis rumicis*.

p. 90, line 3 from bottom, read "*heraculi*" for "*heraclei*" (but do not change line 4 from bottom); and on p. 91, line 4, add honeysuckle to hostplant list.

p. 95, add:

**Rhopalosiphum latysiphon** (Davidson).

*Amphorophora latysiphon* Davidson, *Jour. Econ. Ent.* 5(5):408, figs. 10-13, 1912.

The myrtle aphid.

Maui, Hawaii.

Immigrant. Known from Europe and America; described from California. First recorded in the Territory by Krauss in 1949 from material collected at Olinda, Maui, in 1947 (*Proc. Hawaiian Ent. Soc.* 13(3):326, 1949). The hostplant in Hawaii is not known.

p. 100, add *Nesomicromus vagus* Perkins (Neuroptera: Hemerobiidae) to list of predators of *Toxoptera aurantii*.

p. 108, in line 3 of key add "twice" between "quite" and "as long."

p. 110, at end of first line of key, add "or orchid" after "grass." At end of third line of key add "or orchids . . . 5" after "grasses," and delete the following line and replace with:

- 5(4). On grasses; third antennal segment distinctly longer than fourth . . . . . **granarium** (Kirby).  
On orchids; third antennal segment as long or hardly as long as fourth . . . . . **luteum** (Buckton).

—— add Hawaii to distribution of *Macrosiphum granarium*.

—— at bottom of page add:

**Macrosiphum luteum** (Buckton).

*Siphonophora lutea* Buckton, *Monograph of the British Aphides* 1:119, pl. 8, 1876.

Kauai, Oahu, Maui, Hawaii.

Immigrant. Described from hothouse orchids in England. First reported from the Territory by Look in 1949 (*Proc. Hawaiian Ent. Soc.* 13(3):325, 1949) from specimens collected at Hilo, Hawaii, in March, 1948.

Hostplants: a pest of orchids; *Cattleya*, *Dendrobium*, *Epidendrum*, *Phalaenopsis*.

p. 125, add Maui to the distribution of *Eriosoma lanigera*.

## COCOIDEA

- p. 133 and 135, at top read "Coccoidea" for "Coccoidae."

## MARGARODIDAE

- p. 136, add *Acacia koaia* and ramie to hostplants of *Icerya purchasi*.

## ORTHEZIIDAE

- p. 139. My 1946 paper on the authorship of *Orthezia insignis* was preceded by Lindinger in 1935 (*Ent. Jahrbuch* 44:141), who pointed out the same facts.  
 p. 140, paragraph 2, line 1, *Orthezia insignis* has also been known in Hawaii as "Maui blight."

## PSEUDOCOCCIDAE

- p. 181, add *Tristellateia australasica* to hostplants and *Bothriencyrtus insularis* (Cameron) (Hymenoptera: Encyrtidae) to list of parasites of *Pseudococcus adonidum*.  
 p. 185, transfer *Pseudococcus boninsis* to *Dysmicoccus* Ferris. This and the species noted below, which were formerly placed in *Pseudococcus*, have had their generic assignments changed by Ferris in his *Atlas of the Scale Insects of North America* 6, 1953.  
 p. 189, transfer *Pseudococcus brevipes* to *Dysmicoccus* Ferris of which it is the type; add *Carissa* and sweetpotato to hostplants, and add *Euryrhopalus pretiosa* (Timberlake) (Hymenoptera: Encyrtidae) to list of parasites. The *Anagyrus* previously misidentified as *coccidiivorus* has now been described as *Anagyrus ananantis* Gahan (*Proc. Hawaiian Ent. Soc.* 13(3):357, 1949).  
 p. 201, transfer *Pseudococcus citri* to *Planococcus* Ferris (type of the genus); add Hawaii to distribution; add *Acacia koaia*, *Poinsettia* and *Samanea saman* to hostplants; to list of parasites add *Chrysoplatycerus splendens* (Howard), *Euryrhopalus pretiosa* (Timberlake) and *Leptomastix dactylopii* Howard (Hymenoptera: Encyrtidae).  
 p. 204, transfer *Pseudococcus kraunhiae* to *Planococcus*.  
 p. 222, add *Samanea saman* to hostplants and *Chrysoplatycerus splendens* Howard (Hymenoptera: Encyrtidae) to parasites of *Pseudococcus maritimus*.  
 p. 229, transfer *Pseudococcus nipae* to *Nipaecoccus* Ferris (type of the genus), and add *Broussaisia* to list of hostplants.  
 p. 235, add Hawaii to the distribution of *Pseudococcus nudus*.  
 p. 245, transfer *Pseudococcus vastator* to *Nipaecoccus*.  
 p. 260, add *Hymenocallis littoralis* to hostplants of *Trionymus lounsburyi*.  
 p. 266, add:

***Trionymus rostellum* Lobjell.**

*Trionymus rostellum* Lobjell, *Ann. Ent. Soc. America* 23(2):219, pl. 11, figs. 1-7, 1930.

*Trionymus vallis* Ferris, *Atlas of the Scale Insects of North America* 5:275, fig. 107, 1950.

Oahu.

Immigrant. Described from Mississippi and distributed to California. First found in Hawaii by Beardsley, who first found it near Pearl Harbor in September, 1954.

Hostplant: *Cynodon dactylon*.

Ferris lists the author's name as Hoke, but on her original paper, her name appears as Gladys H. Lobdell.

—— transfer *Trionymus sacchari* to *Saccaricoccus* Ferris (type of the genus). p. 271, to synonymy of *Ferrisiana virgata* add *Pseudococcus bicaudatus* Keuchenius, 1915, from coffee in Java.

#### COCCIDAE

p. 290, add:

**Dactylopius tomentosus** (Lamarck).

*Coccus tomentosus* Lamarck, *Système des animaux sans vertèbres*, p. 299, 1801; Hist. Nat. Anim., ed. II, 4:115, 1835.

*Coccus cacti* subspecies *opuntiae* (Lichtenstein MS.) Cockerell, *U.S. Dept. Agr. (Tech. Ser.)* 4:35, 1896.

Hawaii.

An American species purposely introduced to aid in the control of the *Opuntia* cactus pest in pasture lands.

Hostplants: *Opuntia*.

Predator: *Cryptolaemus montrouzieri* Mulzant (Coleoptera: Coccinellidae).

The Territorial Board of Agriculture and Forestry liberated in May, 1949, at Kohala, Hawaii, a strain, imported from Pomona, California, which attacks *Opuntia cordobensis* but not *megacantha*. In August, 1949, they released at Kawaihae and Waimea, Hawaii, a strain from Australia, but originally from Mexico, which attacks *Opuntia megacantha*.

The correct name of this species needs detailed study. It may be that Lindinger should be followed, and that the name should be: *Dactylopius silvestris* (Thiéry de Ménonville) Lindinger, *Arb. morph. taxon. Ent. Berlin-Dahlem* 10(4):248–252, 1943. Thiéry de Ménonville described and figured two species of cactus coccids, one of which he called *Cochenille silvestre* and which he distinguished from the true cochénille insect, in his little-known book "Traité de la culture du Nopal, et de l'éducation de la Cochenille dans les colonies Françaises de l'Amérique; Précédé d'un Voyage a Guaxaca, part 1:i–cxliv, 1–262; part 2:263–439, supplement; 1–94; 4 colored plates, 1787. *Cochenille silvestre* is discussed on pp. cxxix, 346, 347, etc. Is Thiéry de Ménonville's name available under the rules? The remarkable bibliographer, Sherborn, in his *Index Animalium, Sectio Prima*, p. lii, 1902 (Cambridge Univ. Press), lists the work, but he states that it includes no new species names.

p. 294, add the fungus *Verticilium lecanii* (Zimmerman) to the parasites of *Coccus acuminatus*.

p. 311, add *Schinus* and *Nothopanax guilfoylei* to hostplants and the fungus *Verticilium lecanii* (Zimmerman) to parasites of *Coccus viridis*.

p. 318, add the fungus *Verticilium lecanii* (Zimmerman) to parasites of *Eucalymnatus tessellatus*.

p. 320, add *Comperiella bifasciata* Howard (Hymenoptera: Encyrtidae) to parasites of *Saissetia hemispherica*.

p. 324, add Niihau to distribution of *Saissetia nigra*.

p. 328, add *Mussaenda philippica* var. *aurorea* to hostplants and the fungus *Verticilium lecanii* (Zimmerman) to parasites of *Saissetia oleae*.

p. 336, add litchi to hostplants of *Pulvinaria psidii*.



p. 343. *Ceroplastes rubens* is also found in Tahiti. Add the fungus *Verticillium lecanii* (Zimmerman) to parasites. K. Yasumatsu and T. Tachikawa list additional parasites of this species in Japan in *Jour. Faculty of Agr. Kyushu Univ.* 9(2): 99–120, pls. 1, 2, 1949, and 10(1):1–27, figs. 1–4, 1951.

p. 343, add:

***Ceroplastes cistudiformis*** Townsend and Cockerell.

*Ceroplastes psidii* subspecies *cistudiformis* Townsend and Cockerell, *Zoe* 3:256, 1892.

*Ceroplastes cirripediformis* Comstock, as a misidentification.

Oahu.

Immigrant. Known from Mexico and southwestern United States.

First found in Honolulu by Sherman in December, 1952 (*Proc. Hawaiian Ent. Soc.* 15(2):271, 1954).

Hostplant: *Passiflora edulis flavicarpa*.

Parasites. *Scutellista cyanea* Motschulsky, *Tomocera ceroplastis* Perkins (Hymenoptera: Miscogasteridae), *Aneristus ceroplastae* Howard (Hymenoptera: Aphelinidae).

#### DIASPIDIDAE

p. 352, add *Gardenia* to list of hostplants of *Duplaspidiotus claviger*.

p. 352, add:

***Octaspidiotus araucariae*** Adachi and Fullaway.

*Octaspidiotus araucariae* Adachi and Fullaway, *Proc. Hawaiian Ent. Soc.* 15(1): 89, figs. 7–11, 1953.

Oahu (type locality: Waipio).

Immigrant. Source undetermined, but presumably the Australian Region. First discovered in Hawaii at Waipio, Oahu, in February, 1951, by Beardsley.

Hostplant: *Araucaria excelsa*.

p. 358. *Morganella longispina* is also found in Tahiti; add *Aleurites moluccana*, avocado and *Bauhinia purpurea* to hostplants; add *Aphytis chrysomphali* Mercet (Hymenoptera: Aphelinidae) and *Comperiella bifasciata* Howard (Hymenoptera: Encyrtidae) to parasites.

— add *Prosopis chilensis* to hostplants of *Hemiberlesia cyanophylli*.

p. 361, add *Alyxia*, *Chrysalidocarpus lutescens*, and *Cordyline* to list of hostplants of *Hemiberlesia lataniae*.

p. 366, line 8, remove "none has been recorded from it in Hawaii" and add "*Aphytis chrysomphali* (Mercet) (Hymenoptera: Aphelinidae)."

p. 369, add *Chrysalidocarpus lutescens* to *Chrysomphalus dictyospermi* hostplants.

p. 369, add rose to list of hostplants of *Chrysomphalus ficus* and add *Comperiella bifasciata* Howard (Hymenoptera: Encyrtidae) to parasites.

p. 374, add:

***Radionaspis indica*** (Marlatt).

*Leucaspis indica* Marlatt, *Bull. U.S. Bur. Ent. (tech. series)* 16(2):26, pl. 7, fig. 2, 1908.

*Radionaspis indica* (Marlatt) Ferris, *Atlas of the Scale Insects of North America* 2:153, 1938.

## Oahu.

Immigrant. Known from India and America. First recorded from Hawaii by Defibaugh in 1951 (*Proc. Hawaiian Ent. Soc.* 14(2):226) from specimens collected in Honolulu by Adachi in 1950.

Hostplant: mango (in cracks in bark).

p. 377, add *Rutu graveolens* to hostplants of *Fiorinia floriniae*.

p. 381. The combination *Pseudaulacaspis major* (Cockerell) is not a new combination. The transfer was made by Lindinger in 1935 (*Ent. Jahrbuch* 44:130).

p. 386, add *Chrysalidocarpus lutescens* to *Phenacaspis sandwicensis* hostplants.

p. 390, add *Anthurium*, *Anthurium magnificum*, and *Cordyline* to hostplants of *Pinnaspis buxi*.

p. 394, add:

**Pseudoparlatoria parlatoroides** (Comstock).

*Aspidiotus* (?) *parlatoroides* Comstock, *Cornell Univ., Second Rept. Dept. Ent.* 1883:64.

*Pseudoparlatoria pusilla* Green, *Jour. Bombay Nat. Hist. Soc.* 4:1010, 1928.

*Pseudoparlatoria parlatoroides* (Comstock) Ferris, *Atlas of the Scale Insects of North America* 4:417, 1942 (not 1:117, 1937, which details are in error).

## Oahu.

Immigrant. Known from India and America. First found in Hawaii by Fullaway at Honolulu in June, 1948 (*Proc. Hawaiian Ent. Soc.* 13(3):334, 1949).

Hostplant: *Cyrtopodium*.

**Pseudoparlatoria giffardi** Adachi and Fullaway.

*Pseudoparlatoria giffardi* Adachi and Fullaway, *Proc. Hawaiian Ent. Soc.* 15(1): 87, figs. 1-6, 1953.

Oahu (type locality: Manoa Valley, Honolulu).

Immigrant. Source undetermined, but probably South America. First collected in Hawaii by Giffard in 1907.

Hostplants: *Araucaria cunninghamii*, *Araucaria excelsa*.

Parasite: *Aphytis chrysomphali* (Mercet) (Hymenoptera: Aphelinidae).

p. 404, add *Chrysalidocarpus lutescens* to hostplants of *Parlatoria proteus*.

p. 407, add *Chrysalidocarpus lutescens* to hostplants of *Ischnaspis longirostris*.

p. 412, add *Telsimia nitida* Chapin (Coleoptera: Coccinellidae) to list of predators and *Plagiomerus diaspidis* Crawford (Hymenoptera: Encyrtidae) to list of parasites; add *Chrysalidocarpus lutescens* to hostplants of *Diaspis boisduvalii*.

p. 418, add *Myiophagus* (probably *ucranicus*), a fungus, to list of parasites of *Lepidosaphes beekii*.

p. 422, under *Lepidosaphes pallida*. There appears to be some confusion in taxonomy here, and evidently the form in Hawaii should be known as *Lepidosaphes maskelli* (Cockerell). The presence of the species in Hawaii has now been confirmed by Beardsley's collecting it on an unidentified conifer in Manoa, Honolulu, in April, 1955. See Balachowsky, *Mem. Sci. Institut Pasteur*, p. 87, pl. 15, figs. 3-4, 1954, for discussion.

p. 428, add:

**Odonaspis penicillata** Green.

*Odonaspis penicillata* Green, *Jour. Bombay Nat. Hist. Soc.* 16:346, pl. 1, figs. 14-16, 1905.

Oahu.

Immigrant. Described from bamboo from Ceylon. First found in Hawaii by Beardsley at Foster Gardens, Honolulu, May, 1955.

Hostplant: bamboo.

- p. 440, add to bibliography, the extremely interesting paper by DOUTT, R. L. A COMPARATIVE STUDY OF SPERMATOOZOA IN RELATION TO THE CLASSIFICATION OF MEALYBUGS. Proc. Hawaiian Ent. Soc. 14(3):391-397, figs. 1-2, 1952. Douth demonstrates the soundness of the Ferris classification.

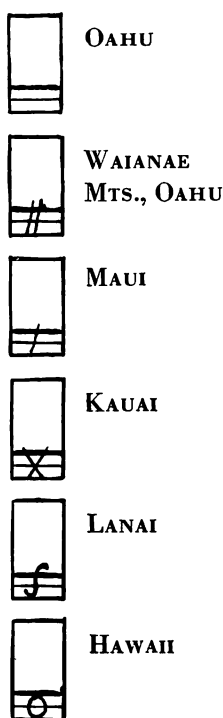


Figure 105—Key to the locality code used by the Rev. Thomas Blackburn to label his Hawaiian insects. The names of species as determined by Blackburn were usually written on the under sides of the cards. Blackburn spent only a few hours on Molokai and he evidently did not collect there. In addition to this code, Blackburn also used a number code, but I do not know the key to that code. Such codes to take the place of field data usually lead to confusion and should be avoided by biologists.

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